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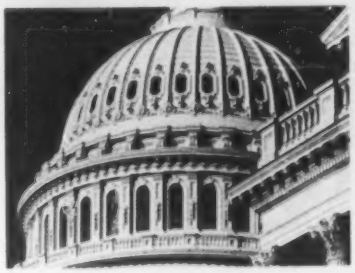

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FINANCIAL REVIEW

SECOND QUARTER EARNINGS PER SHARE DOWN

Despite a 4.0 percent sales increase over the second quarter of 1988, investor-owned electric utility earnings per share (EPS), before extraordinary items, decreased from $0.48 in the second quarter of 1988 to $0.47 in the second quarter of 1989, a 2.1 percent decline. The EPS decrease was due primarily to a lower level of income accruals and expense deferrals and a drop in other "income and deductions-net."

Electric operating revenue increased 6.9 percent in the second quarter of 1989. Rate decisions for a few major utilities contributed approximately one percentage point to this increase. Electric operating expenses increased at a slightly slower rate, 6.7 percent, from $25.0 billion in the second quarter of 1988 to $26.7 billion in the second quarter of 1989. The increase in electric operating revenue led to a 7.7 percent increase in electric operating income on a quarter-to-quarter basis.

Fuel and other operation and maintenance expense increased moderately by 3.0 percent and 8.6 percent, respectively, over last year's second quarter. Despite the small increase, fuel represented only 22.2 percent of operating revenue in the second quarter of 1989.

Allowance for funds used during construction (AFUDC) dropped from $718 million in the second quarter of 1988 to $563 million in the second quarter of 1989, a 21.6 percent decrease.

Total phase-in accruals decreased from $543 million in the second quarter of last year to $431 million in the same quarter of 1989. Phase-in plan accruals have declined to their lowest amount since EEI began tabulating them in the first quarter of 1987.

Other income and deductions net decreased from $286 million in the second quarter of 1988 to $176 million in the second quarter of 1989. This decline is one of the primary reasons for the decrease in EPS before extraordinary items and a cumulative change in accounting principle. The decrease was attributable primarily to plant writeoffs and the losses incurred by non-utility operations.

The return on average common equity (ROE) before extraordinary

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Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Millions of Dollars)

	Three Months Ending June 30,			Twelve Months Ending June 30,		
	1989	1988r	% Change[3]	1989	1988r	% Change[3]
Total Electric Operating Revenues[1]	$33,340	$31,179	6.9	$138,628	$131,863	5.1
Electric Operating Expenses						
Fuel	$ 7,402	$ 7,186	3.0	$ 31,969	$ 31,034	3.0
Other Operation & Maintenance	11,347	10,452	8.6	44,491	41,305	7.7
Depreciation & Amortization	3,817	3,537	7.9	14,614	13,665	6.9
Costs Deferred Under Rate Phase-In Plans	(198)	(296)	(33.0)	(873)	(1,212)	(28.0)
Taxes Other Than Income Taxes	2,623	2,536	3.4	10,720	10,228	4.8
Income Taxes: Federal & Other	1,250	1,041	20.1	6,402	6,235	2.7
Deferred Income Taxes	534	578	(7.7)	2,441	2,777	(12.1)
Investment Tax Credits, Net	(80)	(25)	(214.6)	(327)	219	N.M.
Total Electric Operating Expenses	$26,695	$25,010	6.7	$109,438	$104,252	5.0
Electric Operating Income	$ 6,645	$ 6,169	7.7	$ 29,190	$ 27,611	5.7
Other Utility Operating Income	185	205	(9.6)	1,235	1,195	3.3
Total Utility Operating Income	$ 6,830	$ 6,374	7.2	$ 30,425	$ 28,807	5.6
Other Income & Deductions—Net	176	286	(38.7)	(972)	773	N.M.
Phase-in Deferrals	233	247	(5.8)	1,001	1,052	(4.8)
Allowance for Other Funds Used During Construction	277	372	(25.6)	1,315	2,052	(35.9)
Total Income Before Interest Charges	$7,515	$7,279	3.2	$ 31,769	$ 32,683	(2.8)
Interest Charges						
Interest on Long-Term Debt	$ 3,816	$ 3,645	4.7	$ 15,032	$ 14,740	2.0
Other Interest Expenses & Charges	315	267	18.0	1,236	844	46.4
Allowance for Borrowed Funds Used During Construction	(286)	(346)	(17.2)	(1,287)	(1,595)	(19.3)
Net Interest Expenses & Charges	$ 3,845	$ 3,566	7.8	$ 14,980	$ 13,989	7.1
Net Income Before Extraordinary Items	$ 3,669	$ 3,713	(1.2)	$ 16,789	$ 18,694	(10.2)
Extraordinary Items	0	0	N.M.	(57)	52	N.M.
Cumulative Effect of a change in accounting principle	(17)	0	N.M.	(36)	(1,737)	N.M.
Net Income	$ 3,653	$ 3,713	(1.6)	$ 16,697	$ 17,010	(1.8)
Preferred Dividends Declared	532	547	(2.9)	2,137	2,271	(5.9)
Net Income Available for Common	$ 3,121	$ 3,166	(1.4)	$ 14,560	$ 14,738	(1.2)
Common Dividends Declared	3,126	3,212	(2.7)	12,657	12,554	0.8
Additions to Retained Earnings	($5)	($47)	89.5	$ 1,903	$ 2,184	(12.9)
Average Shares Outstanding (Millions)[2]	6,705	6,611	1.4	6,691	6,598	1.4
Earnings Per Share Before Extraordinary Items and the Cumulative Effect of a change in accounting principle[2]	$ 0.47	$ 0.48	(2.1)	$ 2.19	$ 2.49	(12.0)
Earnings Per Share After Extraordinary Items and the Cumulative Effect of a change in accounting principle[2]	$ 0.47	$ 0.48	(2.1)	$ 2.18	$ 2.23	(2.2)
Common Dividends Per Share[2]	$ 0.47	$ 0.49	(4.1)	$ 1.89	$ 1.90	(0.5)

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service
NOTE:
[1]Revenues are adjusted for intra-industry sales for resale of electricity.
[2]Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
[3]Percent changes may reflect roundings.
r—Revised to reflect company restatements.
N.M.—Not Meaningful.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Millions of Dollars)

Assets	June 30, 1989	June 30, 1988r	Percent Change[3]
Utility Plant[1]			
Utility Plant (Including Nuclear Fuel)	$476,030	$452,781	5.1
Less Accumulated Depreciation	137,640	124,923	10.2
Total	$338,390	$327,858	3.2
Construction Work in Progress	35,604	42,352	(15.9)
Net Utility Plant	$356,119	$370,210	(3.8)
Investments	32,506	29,519	10.1
Current Assets	39,775	40,264	(1.2)
Deferred Debits	34,170	32,381	5.5
Total Assets	$480,445	$472,374	1.7
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 93,622	$ 92,342	1.4
Retained Earnings	51,944	51,511	0.8
Preferred Stock	26,747	27,599	(3.1)
Long-Term Debt	169,911	168,390	0.9
Total Capitalization	$342,224	$339,842	0.7
Current Liabilities			
Short-Term Debt	$ 11,649	$ 11,078	5.2
Long-Term Debt Due Currently	4,902	4,932	(0.6)
Other Current Liabilities	29,885	28,536	4.7
Total Current Liabilities	$ 46,435	$ 44,546	4.2
Deferred Credits			
Capital Lease Obligations, Non-Current Portion	$ 5,618	$ 4,473	25.6
Accumulated Deferred Income Taxes[2]	48,014	45,733	5.0
Accumulated Deferred Investment Tax Credits	16,445	17,031	(3.4)
Other Deferred Credits	21,709	20,749	4.6
Total Deferred Credits	$ 91,786	$ 87,986	4.3
Total Capitalization & Liabilities	$480,445	$472,374	1.7

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service
[1]Includes non-electric utility plant.
[2]Includes property-related deferred income taxes.
[3]Percent changes may reflect roundings.
r—Revised to reflect company restatements.

items was 10.1 percent for the twelve-month period ending June 30, 1989, down from the 11.5 percent reported for the twelve months ending June 30, 1988.

Balance Sheet

The industry's balance sheet continues to improve as construction work in progress (CWIP) decreased from $42.4 billion as of June 30, 1988, to $35.6 billion as of June 30, 1989. CWIP as a percentage of net plant in service dropped from 12.9 percent to 10.5 percent during the same period. Associated with the decrease in CWIP was an increase in total utility plant of 5.1 percent. The percentage increase for utility plant is lower than it has been for many quarters and reflects the continuing reduced level of new generating plant construction.

Investments for the industry as of June 30, 1989, showed an increase of 10.1 percent to $32.5 billion, up from the $29.5 billion recorded June 30, 1988. The increase represents the inclusion of the assets of subsidiary operations of holding companies, such as banking and insurance, brought on by accounting changes caused by a change in a financial accounting principle (SFAS 94).

Total capitalization at June 30, 1989, rose slightly by 0.7 percent, representing an increase of $2.4 billion over June 30, 1988.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample is representative of approximately 99.4 percent of the investor-owned electric utility industry's total assets and 96.5 percent of its total revenues. The sample data were adjusted to represent the entire investor-owned electric utility industry by using the Standard & Poor's Utility Compustat II database.

Contributed by Edison Electric Institute's Finance and Accounting Department.

TECHNOLOGY REVIEW

KEEPING UP WITH MICROCOMPUTERS

Currently, there are approximately 18 million microcomputers and workstations installed in American businesses and, according to *PC Magazine*, the total investment in new installations and upgrades is growing by 25 percent a year. To date, America's investment in microcomputers alone is estimated to be $78 billion. By 1992, the installed based of microcomputers in the U.S. will increase from approximately 20 million today to 36.7 million, according to projections by Dataquest, a market research firm. The Congressional Office of Technology Assessment predicts that by the early 1990s there will be a computer terminal for every three office workers in this country. Because of shared computer environments, the number of employees using microcomputers will be much higher than the installed base.

While investment in office automation continues unabated, so does the rapid advancement of computer technology. Today's advanced workstations are bringing power to the desktop that was once only available through mainframe computers. New applications, such as desktop publishing and database management, are becoming increasingly commonplace with corporations. LANs are helping managers and staff share strategic information that once remained unaccessible.

Meanwhile, business spending on these high-end technology systems continues to rise. International Data Corp., another market research firm, forecasts that sales of workstations will grow at a compound annual rate of more than 36 percent through 1992. Additionally, according to Dataquest, LAN connection shipments are growing by 25 percent a year.

Yet, despite this tremendous investment in office computing technology, many American businesses are not fully utilizing the productivity and strategic potential of their multimillion dollar office automation systems. At leading Fortune 500 corporations and small businesses alike, technology advances are frequently outpacing the ability of employees to use them.

In a recent study of Fortune 500 companies, the nonprofit National Training & Computers Project (NTCP) found that most end-users are underachievers who do not fully leverage the features or power offered by their desktop computers. The typical employee uses only a fraction of the capabilities offered by his or her business software application program.

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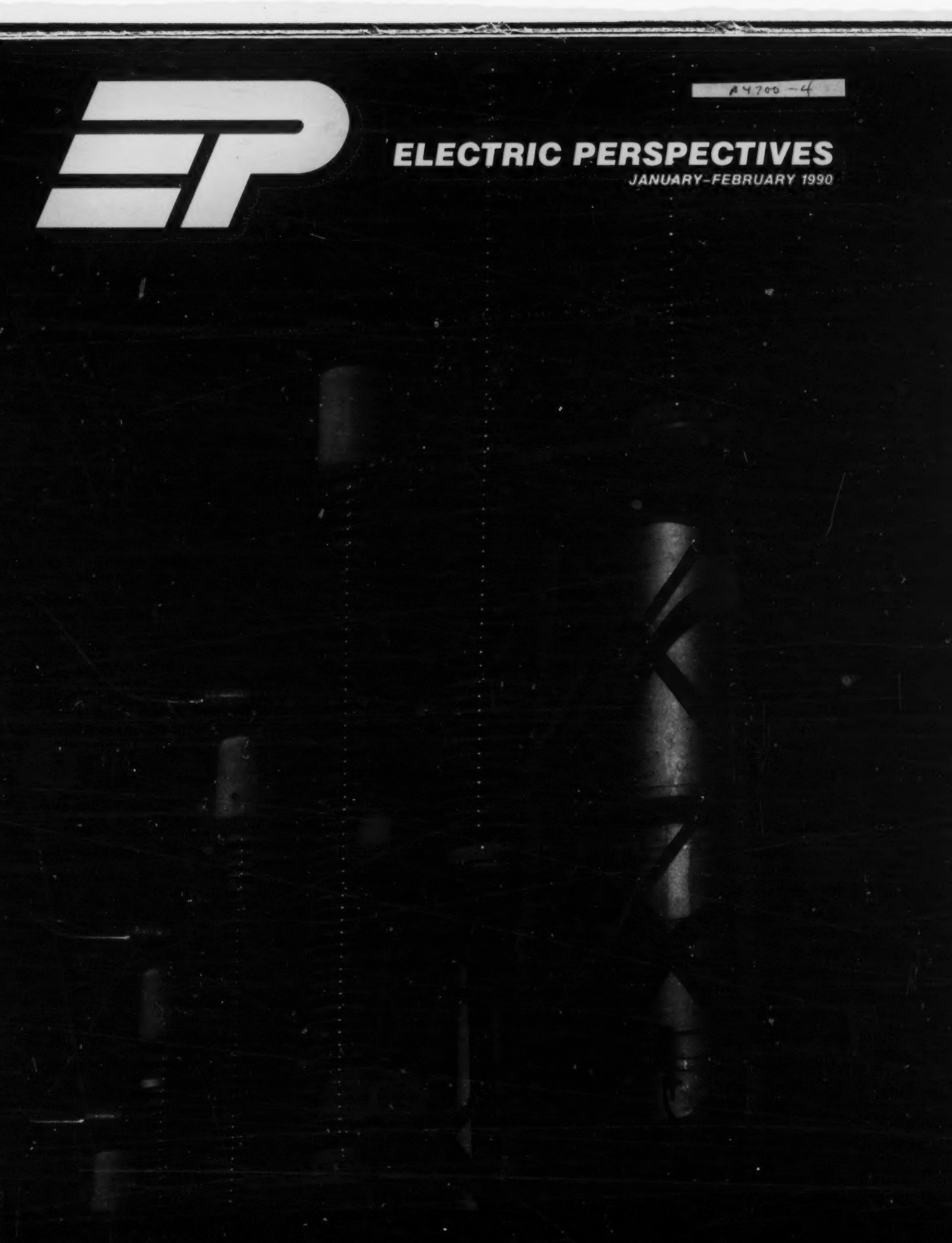

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Mark A. Boroush and Peter M. Stern

Alternative Energy Futures

Variations on the economic assumptions in the Electricity Futures Project's reference case provide insights about future U.S. energy requirements.

The Nation's use of electricity and other energy forms moved up sharply in 1987 and 1988. Total end-use energy requirements grew by 1.9 percent and 3.4 percent, respectively, over the previous year's level—differing dramatically from the average annual increase of 0.1 percent that had characterized the period from 1980 to 1986. Requirements for electricity grew even faster, by 5.1 percent in 1987 and 4.8 percent in 1988—markedly above the 2.2 percent average growth rate in the 1980–86 period.

Is this rise a short-term aberration or the beginning of a new trend? Clearly, the healthy growth of the economy, driven by more than five years of an unprecedented business expansion, must have been a major cause of the energy use uptick. Real growth of GNP in 1987 was 3.4 percent, topped by around 4 percent in 1988; compare that with a GNP growth rate averaging 2.7 percent annually over the 1980–86 period. Abnormal weather—with proportionately greater demand for space heating and cooling—also played a role. And, in electricity's case, an improving price position relative to other fuel options surely added momentum.

These recent growth records are especially noteworthy at a time when it has been the conventional wisdom to lower expectations of demand growth for electricity and other energy forms. Yet, as 1989 data are becoming available, the picture is becoming more puzzling. Economic growth remains strong, but the year's apparent growth in demand is likely to be flat for total end-use energy requirements and less than 2 percent for electricity.

This article, an outgrowth of Edison Electric Institute's Electricity Futures Project, is the first of a pair exploring various forces that will affect energy demand over the next 25 years. The second will consider the significance of improving end-use technologies for long-range energy requirements.

The Electricity Futures Project

EEI's Electricity Futures Project was initiated in mid-1987 to bring a longer-term focus upon forces capable of affecting the long-range outlook for electric power use. (See "Electricity Futures: America's Economic Imperative" in the March-April 1989 issue of *Electric Perspectives* for a summary of the Project's major findings.) The Project is intended to cast a spotlight upon anticipated changes in the Nation's economic, technological, and demographic makeup and to interpret these changes in the context of the future energy requirements of consumers in all end-use classes. Thus, the Project has dealt with many incipient and established trends:

- the shifting composition of economic output and employment, market globalization, the new rigors of international competition;
- the prospect of a significant slowing in the Nation's rate of population growth, with parallel implications for household formation and expansion of the labor supply;
- the growing stream of new products and processes derived from advanced R&D (domestic and international), which will change business operations, lifestyles, skill requirements, and the work place through the 1990s and beyond;
- the continuing push for improved energy efficiencies, under the stimulation of price, competitive pressures, improved consumer knowledge, public policies, and utility-sponsored programs;
- stable (maybe even slightly declining) real electricity costs through the 1990s and perhaps thereafter.

In 1988, the Project staff completed a Reference Case for estimating future levels of energy demand to the year 2015. This baseline scenario incorporated the current expectations in each of the domains described above.

Under the Project's Reference Case, the Nation's total end-use energy requirements are projected to grow at an average annual rate of 1.2 percent from 1989 through the year 2000, slowing a bit to 1.1 percent annually in the decade and a

Mark Boroush and Peter Stern are with The Futures Group, a Glastonbury, CT firm.

Ron Sherman/Uniphoto

Table 1

The Reference Case Forecast

Year	1980	1988	2000	2015
DELIVERED END-USE ENERGY				
quadrillion Btu	53.11	56.33	64.68	76.04
average annual growth rate, previous period	—	0.8%	1.2%	1.1%
ELECTRICITY USE				
quadrillion Btu	7.30	9.15	12.32	15.31
billion kWhr	2,132	2,647	3,611	4,487
average annual growth rate, previous period	—	2.9%	2.6%	1.5%
share of total end-use energy	13.7%	16.2%	19.0%	20.1%

Source: Electricity Futures Project, 1989. Projections differ slightly from the 1988 numbers due to updates for actual 1988 values.

half beyond 2000. For electricity, the outlook calls for a 2.6 percent growth rate from 1989 through 2000, then a slowing to 1.5 percent in the 2000–15 period. (See Table 1.)

This is a setting of improving end-use energy efficiencies and increasing electrification. The U.S. economy of 2015 is projected to require around 25 percent less energy per real dollar of GNP than it does today. Electricity's share of total end-use energy is expected to grow from around 16 percent in 1988 to more than 20 percent in 2015, a significant gain in market share.

The Reference Case scenario is clearly based on a moderate outlook for economic growth, well within the mainstream of current economic thinking. It also assumes no major surprises—no critical interruptions in the flow of international oil, no major new initiatives in public policies affecting energy supplies or consumption, no economic or financial disruptions significantly affecting the U.S. or its international trading partners. (See Table 2.)

In 1989, we moved beyond the baseline, examining several alternative cases in order to test the sensitivity of the Reference Case projections to a number of alternative assumptions about the structure and growth of the economy, the rate of population growth, and the pace of new technology penetration. This article focuses on the possible significance of alternative economic expansion patterns upon future energy requirements. Conclusions are drawn by comparing the Reference Case outlook with the results of selected alternative cases.

The Impact of a Shifting Economic Structure

The pace at which the country's requirements for energy increase depends not only on the overall rate of economic growth but also on its composition. There are considerable differences among the country's numerous types of businesses in the way energy and electricity are used. Highly energy-intensive manufacturing such as paper & allied products or chemicals presently utilizes ten to twenty times more energy per unit of output than such less energy-intensive segments as electrical equipment or transportation equipment. In the commercial sector, energy-intensive segments such as restaurants or health facilities utilize two to three times more energy per square foot of floor space than such less energy-intensive segments as retail establishments or warehouses. (See Table 3.)

Such differences are significant as one realizes that a marked change in the makeup of the Nation's economy has taken place since the early 1950s. Less and less of output and employment is accounted for by the goods-producing sector and more and more by the provision of services. Over the next several decades this broad shift is expected to continue. To be sure, a strong emphasis on the production of tangible goods is certain to continue. It is likely, though, that the intra-sectoral composition of manufacturing will change significantly, with faster growth occurring in segments that involve high technology and customized products, such as advanced machinery, microelectronics, computers and communication equipment, and biotechnology. Intra-sectoral shifts will also take place within the services-producing sector—where much of the new growth in jobs can be expected.

What is the significance of these structural shifts for the country's future energy requirements—will it be major, minor, or barely perceptible? Comparison of the energy outlook in the Reference Case with that of two alternative cases provides a useful guide.

Our first alternative assumes that the share of GNP accounted for by each of the commercial and industrial segments remains fixed at the 1987 value throughout the forecast

Table 2

Major Reference Case Assumptions

Year	1980	1988	2000	2015
THE ECONOMY				
gross national product, billion 1977$	2,145	2,689	3,462	4,754
average annual growth rate	—	2.9%	2.3%	2.1%
gnp per capita, 1977$	9,417	10,947	12,883	16,324
industrial shipments, billion 1977$	1,747	2,080	2,975	4,216
average annual growth rate	—	2.2%	3.0%	2.4%
commercial floor space, billion sq ft	46.0	57.4	71.9	85.0
average annual growth rate	—	2.8%	1.9%	1.1%
export share, gross domestic product	9.3%	11.0%	12.5%	13.0%
DEMOGRAPHICS				
resident population, millions	227.8	245.6	268.7	291.2
average annual growth rate	—	0.9%	0.8%	0.5%
total households, millions	80.8	92.0	110.2	124.4
average annual growth rate	—	1.6%	1.5%	0.8%
ENERGY				
prices, 1987$ per million Btu				
electricity	20.7	18.3	17.1	21.3
natural gas	5.5	4.5	6.0	9.4
petroleum	6.8	3.6	5.7	8.8
policy	modest pressures for efficiency—Federal appliance standards, state & local building codes, utility programs; no major changes in environmental policies			

Source: Electricity Futures Project, 1988 and 1989. Based on inputs from The Futures Group, Inc., the INFORUM group at the University of Maryland, and EEI. Note that average annual growth rates are for previous period.

period. The Reference Case's other assumptions—including the trend in energy prices, the rate of population growth, total GNP level, a "normal" weather pattern—remain in force. This means that the chief variant in the alternative case is the assumption that the structural economic changes embodied in the Reference Case will not take place.

As shown in Table 4, the overall energy requirements are likely to be smaller under the Reference Case than under the alternative case which "stops" the structural change trend. The overall difference, however, is comparatively small: energy use in 2015 is but 2 percent less than it would be if the 1987 composition of commercial and industrial segments were to remain fixed. The difference in electricity requirements is even smaller, in fact, close to insignificant.

Much more pronounced are the impacts when the sectors are considered separately. Industry's 2015 requirements for all end-use energy are lower by almost 7 percent under the Reference Case than under the alternative case; those for electricity are lower by 3 percent. This is not a surprising finding since structural change in the industrial sector (which the Reference Case incorporates and the alternate case does not) anticipates agriculture, mining, and construction (all with moderate-to-high energy intensities) to continue claiming markedly smaller shares of the total economic output, while manufacturing segments which involve advanced machinery, electronics, computers, and communications technology (all of which are low in energy intensity, but highly dependent on electricity) will be growing much faster than the sector as a whole.

Interestingly, in the commercial sector the differences between the Reference Case and the alternative scenario point in the opposite direction. The Reference Case indicates total energy as well as electricity requirements by 2015 to be higher by about 3 percent than in the alternative case. The explanation is that such segments as health facilities, hotels/motels, and office buildings (all with moderate-to-high energy intensities) are expected to experience significant growth, while the segments with low energy-use intensities (particularly schools and warehouses) are likely to undergo a proportionate decline in requirements.

Thus, the downward effect in the industrial sector depicted in the Reference Case is buffered by a significant upward effect in the commercial sector. This accounts for what are only modest differences in energy use between the two scenarios when looked at in aggregate terms.

The Reference Case assumes that the share of the Nation's total economic output accounted for by services-producing firms will grow

Table 3

Comparative End-Use Energy Intensities

Industrial Sector	1987 1000 Btu per 1977$ output	1987 Electric Share
Agriculture	5.7	18.2%
Mining	21.7	24.2%
Construction	5.1	4.7%
Food & Kindred Products	3.9	18.6%
Tobacco Products	1.6	23.5%
Textile Mill Products	5.3	35.4%
Apparel & Textile Products	1.1	43.2%
Lumber & Wood Products	4.2	29.2%
Furniture & Fixtures	2.4	31.7%
Paper & Allied Products	35.3	12.7%
Printing & Publishing	1.4	44.7%
Chemicals & Allied Products	17.1	19.6%
Petroleum & Coal Products	24.3	6.0%
Rubber & Miscellaneous Plastics	4.4	41.6%
Leather & Leather Products	2.2	26.2%
Stone, Clay, & Glass	25.6	12.6%
Primary Metals	25.2	20.8%
Fabricated Metal Products	3.3	30.7%
Non-electrical Machinery	1.9	38.0%
Electrical Equipment	1.7	49.5%
Transportation Equipment	1.9	36.5%
Instruments & Related Products	2.2	32.0%
Miscellaneous Manufacturing	1.7	36.8%

Commercial Sector	1000 Btu per square foot of floor space	Electric Share
Restaurants	269.9	43.1%
Health facilities	200.6	31.2%
Groceries	165.2	57.8%
Hotels & Motels	162.6	39.4%
Offices—small	135.5	42.4%
Offices—large	120.7	49.6%
Elem & Sec Schools	110.6	19.2%
Colleges & Univ	93.4	40.4%
Retail Buildings	86.6	46.1%
Warehouses	78.1	37.8%
Miscellaneous Bldg	82.6	37.7%

Source: Electricity Futures Project, 1988.

by just 1 percent from its current share of 53 percent over the entire forecast period. What if that pace accelerated markedly, so that the services-producing sector would account for almost 60 percent of GNP by 2015? In this second alternative case, we continue to assume that energy prices, the rate of population growth, the level of GNP, national weather patterns, etc. remain the same as in the Reference Case.

Again, we find the impacts of the permutation to be comparatively small. The "accelerated services" scenario yields total end-use energy requirements that are about 3 percent less in 2015 than in the Reference Case; electricity requirements are about 2 percent less. (See Table 4.)

The reasons for this shift are, once again, more apparent when the sectors are separately examined. Steep declines (of almost 11 percent) in industry's requirements for electricity and other energy forms are matched by sizeable increases (of around 9 percent) in the commercial sector. As discussed earlier, structural economic change creates an industrial sector with a proportionately greater output in low energy intensity segments and a commercial sector with more growth in higher energy intensity segments. Here, too, the commercial sector's increase buffers the sharp downward movement in the industrial sector's energy demand.

What about the Uncertainties in Future Population Growth?

The pace of population growth is of obvious consequence to any estimate of future energy requirements. The rate at which a given population grows can influence the rate of new household formation, which, in turn, directly impacts the number of new residential custom-

Table 4

The Reference Case vs. No Shifts & Accelerated Shifts in the Composition of the Economy
Quadrillion Btu Annually

	1988	Ref Case 2000	No Shift 2000	Accel Shift 2000	Ref Case 2015	No Shift 2015	Accel Shift 2015
TOTALS							
All End-Use Energy	56.3	64.7	65.6	64.0	76.0	77.7	73.8
Electricity	9.2	12.3	12.3	12.3	15.3	15.4	15.0
COMMERCIAL SECTOR							
All End-Use Energy	6.3	7.4	7.3	7.7	8.4	8.2	9.2
Electricity	2.7	3.7	3.6	3.8	4.3	4.2	4.7
INDUSTRIAL SECTOR							
All End-Use Energy	17.8	22.7	23.8	21.8	28.9	30.8	25.8
Electricity	3.3	4.7	4.8	4.5	6.7	6.9	6.0

Source: Electricity Futures Project, 1989

ers for electricity and other energy forms. Population growth also has a significant effect on a nation's or region's potential for economic expansion, through the rate of labor force growth (or contraction) and the size of the consumer base—though it should be noted that such influences are complexly shaped by such other factors as investment, productivity, and disposable household income levels. Population growth also has a direct effect upon the demand for transportation services, for both business and personal uses.

Future population growth—the balance between births, deaths, and net migration—is widely regarded as one of the most stable dimensions of social change encountered by forecasters. And, indeed, it is, comparatively speaking. But even here, there are assumptions and uncertainties about key demographic components that can lead to a sizeable range of forecasts over the long run.

The Census Bureau's "middle series" projection is the most widely used estimate of future population growth. That projection currently calls for gradual but significant decreases in the rate at which the resident population is expected to grow over the next several decades—from an average rate of about 1.0 percent as annually experienced over the last 15 years, to about 0.8 percent per year in the 1990s, and then to 0.5 percent in the years between 2000 and 2015. Of equal importance, the rates of household formation and civilian labor force expansion also face a downward trend. The Census Bureau's "middle series" outlook is the one incorporated in the Reference Case.

Though less widely quoted, the Census Bureau also has identified "upside" and "downside" scenarios. These reflect alternative assumptions about future birth, death, and migration rates among the country's diverse social segments. They provide rather contrasting perspectives on the Nation's population trajectory.

The upside view, known as the "high series" projection, calls for an average annual growth of about 1 percent over the full time horizon of the Electricity Futures Project. This is about the same rate as the one experienced over the past 15 years. The outcome of this projection places the country's year 2015 population almost 16 percent above the level projected by the "middle series." On the downside, the "low series" projection reflects an average annual growth of 0.4 percent in the 1990s and 0.2 percent in the 2000–15 period, with the year 2015 population total being around 10 percent below that of the "middle series." Household formation and the rate of expansion of the civilian labor force are likewise affected by these range-defining series.

Are these differences significant from the standpoint of future energy requirements? Comparing the Reference Case's energy outlook with those of alternative scenarios based on the Census Bureau's "low" and "high" population growth series provides a useful perspective.

As in the previous exercise, all of the Reference Case's assumptions not affected by population change were retained, e.g., the trend in energy prices, shifting composition of economic output, normal weather nationally, etc. This impact assessment includes the effects of a smaller/larger household base on overall residential energy requirements, the effects of less/more economic growth on commercial and industrial sector energy requirements, and the derived effects of fewer/more households and less/more economic growth on the demand for transportation.

The "low" alternative case yields a 2015 demand for all end- use energy and electricity requirements

John Feingersh/Unphoto

Various assumptions regarding population growth rates—and their attendant impact on the growth of residential customers—appear to affect electricity demand less than they do total end-use energy requirements.

Table 5

The Reference Case vs. Lower & Higher Population Growth Scenarios
Quadrillion Btu Annually

	1988	Ref Case 2000	Low 2000	High 2000	Ref Case 2015	Low 2015	High 2015
TOTALS							
All End-Use Energy	56.3	64.7	63.5	65.4	76.0	71.7	78.8
Electricity	9.2	12.3	12.1	12.5	15.3	14.4	16.0
RESIDENTIAL SECTOR							
All End-Use Energy	10.3	10.5	10.4	10.8	10.4	9.8	11.2
Electricity	3.0	3.8	3.7	3.9	4.1	3.9	4.5
COMMERCIAL SECTOR							
All End-Use Energy	6.3	7.4	7.3	7.5	8.4	7.9	8.6
Electricity	2.7	3.7	3.6	3.7	4.3	4.1	4.4
INDUSTRIAL SECTOR							
All End-Use Energy	17.8	22.7	22.3	22.9	28.9	27.2	29.7
Electricity	3.3	4.7	4.6	4.8	6.7	6.3	6.9
TRANSPORTATION							
All End-Use Energy	21.8	24.0	23.5	24.2	28.4	26.7	29.2
Electricity	0.1	0.1	0.1	0.1	0.2	0.2	0.2

Source: Electricity Futures Project, 1989

which is almost 6 percent below that generated by the Reference Case. Differences present themselves most sharply in the post-2000 period. The "high" alternative yields an upside for both total end-use energy and electricity of just over 4 percent—again, with most of the difference manifested after the year 2000. (See Table 5.)

Not surprisingly, given the derived character of energy demand, the sector-by-sector differences are largely proportional to the overall size of the population changes. That differences in energy use are more marked in the post-2000 period is due chiefly to the fact that the Census Bureau's alternative projections envision greater differences in the population growth rate after 2000. Somewhat larger or smaller impacts in both the industrial and

commercial sectors might result in either the high or low case with differing assumptions about the prevailing rate of productivity growth, the growth of disposable income, and the extent to which supply meets demand in the labor market. But, the economic assumptions used in the Reference Case provide a useful range of outcomes.

Overall, the effects of differential population growth rates are likely to be a good deal more significant than those emerging from the earlier exercise dealing with structural change in the composition of the economy. Note, however, that electricity requirements are less affected by "high" versus "low" population growth than total end-use energy requirements.

Table 6

The Reference Case vs. Slower & Faster GNP Growth Scenarios

	1988	Ref Case 2000	Pessimistic 2000	Optimistic 2000	Ref Case 2015	Pessimistic 2015	Optimistic 2015
TOTALS							
All End-Use Energy	56.3	64.7	58.7	71.4	76.0	60.7	97.0
Electricity	9.2	12.3	11.4	13.4	15.3	12.7	18.9
RESIDENTIAL SECTOR							
All End-Use Energy	10.3	10.5	10.5	10.5	10.4	10.4	10.4
Electricity	3.0	3.8	3.8	3.8	4.1	4.1	4.1
COMMERCIAL SECTOR							
All End-Use Energy	6.3	7.4	6.6	8.3	8.4	6.4	11.1
Electricity	2.7	3.7	3.3	4.1	4.3	3.3	5.7
INDUSTRIAL SECTOR							
All End-Use Energy	17.8	22.7	20.2	25.5	28.9	22.1	38.1
Electricity	3.3	4.7	4.2	5.3	6.7	5.1	8.8
TRANSPORTATION							
All End-Use Energy	21.8	24.0	21.3	27.0	28.4	21.8	37.5
Electricity	0.1	0.1	0.1	0.1	0.2	0.1	0.3

Source: Electricity Futures Project, 1989.

Differences in the Future Pace of National Economic Growth

Anyone can readily articulate an "upside" as well as a "downside" variant to the modest pace of economic expansion assumed in the Reference Case. It is certainly possible for the path of GNP growth (on a real basis) to deviate from the 2.0–2.5 percent range assumed as the "best guess" under current expectations. This third set of variations on the Reference Case, therefore, sought to develop both pessimistic and optimistic economic outlooks which do not defy credibility.

Modern industrialized economies are complex behavioral entities that are becoming even harder to decipher under the influence of accelerating international integration and interdependence. Accordingly, a rather wide range of future developments can be postulated, a range that encompasses significantly higher or lower rates of future economic growth.

A useful pair of extremes can be assembled from contrasting assumptions about labor force growth and changes in labor productivity—the product of which provides a first approximation of the potential for real GNP growth. The "high" and "low" labor force growth rates alluded to in the earlier discussion of population growth provide one pair of a useful set of assumptions. The other pair can be drawn from "high" and "low" assumptions of future labor productivity trends based on the Nation's mostly poor record of the 1970s and early 1980s, as well as the much better results attained in more recent years. These assumptions suggest a "pessimistic" GNP growth path averaging 1.5 percent in the 1990s and 1.1 percent in the 2000–15 period. The "optimistic" path, on the other hand, would bring about an average annual growth rate of 3.5 percent in the 1990s and an almost equally buoyant rate of 3.2 percent in 2000–15.

Imposing these alternative GNP growth rates upon the previously listed Reference Case assumptions offers some very telling implications for future energy requirements. (See Table 6.) In the "optimistic" GNP growth case, total end-use energy needs are projected to be almost 28 percent greater than in the Reference Case for the year 2015; electricity requirements are more than 23 percent greater. In the "pessimistic" case, on the other hand, total end-use energy requirements in 2015 are almost 20 percent lower than in the Reference Case; and electricity requirements are 17 percent lower.

Clearly, the overall rate at which the national economy will be growing is a most sensitive determinant of future energy requirements—no

surprise, to be sure, but a reinforcement of experienced utility forecasters' reliance on GNP trend analysis (and the measurement of the impact of macroeconomic changes on service area economic indicators).

Concluding Observations

Three sets of alternatives to the Reference Case have been presented here to help us gain a better understanding of what is likely to influence energy requirements over a longer time horizon. Sensitivity analyses are always desirable to bound an uncertain future. While a more detailed set of scenarios than the ones examined here could well be explored, the present analysis provides a useful gauge of the significance for energy of alternative socioeconomic growth prospects.

In summary, the ongoing structural shifts in the composition of the economy herald a declining rate of growth in all forms of energy. Comparatively speaking, though, the overall impact of these shifts appears to be modest over the next several decades, as energy requirements decrease in some sectors of the economy and increase in others.

Uncertainties about the Nation's long-run population growth and its effects on the economy clearly add "upside" and "downside" risks to both overall energy use and electricity requirements. But, while changes in population growth rates exert a more powerful effect than structural change in the economy, the demographic change scenarios tell us that even major departures from rates considered most likely to prevail over the next several decades do not appear by themselves to create drastic perturbations in future energy demand.

The same cannot be said about the effects of an accelerated or decelerated pace of real economic growth. Leaving aside the prospects for improved efficiencies at the point of use, future levels of demand for total end-use energy and electricity in particular could be quite different depending on the rate at which economic expansion occurs over the next 25 years.

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FINANCIAL REVIEW

1988 FUEL COSTS

The composite average cost per million British thermal unit of fossil fuels consumed for electric generation by the utility industry in 1988 was 170.7 cents, a 3.9 percent drop below the 177.7 cents averaged in 1987. Both coal and oil experienced a decrease while gas experienced a slight increase. Nuclear fuel costs on the same per-million-Btu basis rose 2.2 percent. (See Table 1.)

The average cost of coal per ton consumed decreased 4.0 percent in 1988 to $31.99 from $33.32 in 1987. On a per-million-Btu-consumed basis, the average cost of coal was 152.2 cents, 3.5 percent lower than the 1987 cost of 157.8 cents. The average cost per ton was highest in New England and lowest in the West North Central Division. On a per-million-Btu-consumed basis, however, average costs were highest in Alaska and lowest in the Mountain Division.

The average cost of oil per barrel consumed in 1988 was $16.32, 14.3 percent lower than in 1987. Likewise, the average cost of oil per million Btu consumed by the electric utility industry was 14.4 percent lower than 1987, dropping from an average of 304.2 cents to 260.5

Table 1
Average 1988 Fuel Costs: Electric Utility Industry

	Fossil Composite Averages			Coal		Oil		Gas		Nuclear	
	Year	Cost per Million Btu Consumed	Cost of Fuel per Net kWh	Cost per Million Btu Consumed	Cost per Ton	Cost per Million Btu Consumed	Cost per Bbl	Cost per Million Btu Consumed	Cost per MCF	Cost per Million Btu Consumed	Cost per Net kWh
New England	1988	224.4¢	2.29¢	194.3¢	$51.07	237.2¢	$14.93	225.4¢	231.22¢	79.13¢	.854¢
	1987	252.9	2.58	195.4	51.38	282.0	17.80	244.8	251.27	84.90	.905
Middle Atlantic	1988	192.4	1.98	154.3	38.78	268.3	16.74	245.6	252.64	65.29	.712
	1987	205.6	2.12	156.6	38.98	311.5	19.37	272.7	280.49	68.67	.751
East North Central	1988	166.2	1.72	164.1	36.44	325.5	20.06	278.3	147.35	76.48	.830
	1987	174.5	1.81	172.2	38.34	385.1	24.00	298.1	163.17	70.15	.766
West North Central	1988	122.2	1.33	120.2	20.89	350.5	20.96	213.1	210.89	58.25	.621
	1987	129.0	1.41	127.2	22.40	396.5	23.27	225.3	223.98	58.38	.623
South Atlantic	1988	181.8	1.81	172.8	42.92	246.4	15.54	215.6	217.77	68.05	.729
	1987	190.5	1.90	175.6	43.55	292.9	18.44	271.4	273.80	64.22	.689
East South Central	1988	157.3	1.57	155.5	37.12	356.0	21.76	190.0	194.26	91.48	1.009
	1987	162.1	1.64	161.0	38.57	405.6	24.07	188.2	193.54	74.13	.830
West South Central	1988	180.2	1.89	153.7	23.82	418.9	25.63	208.9	216.40	81.96	.878
	1987	183.1	1.92	161.0	24.71	467.9	28.23	205.1	212.70	85.96	.924
Mountain	1988	116.6	1.24	111.7	21.73	296.5	18.21	222.9	227.82	81.77	.849
	1987	116.6	1.25	111.6	21.74	324.4	19.83	235.2	241.25	85.05	.885
Pacific	1988	266.2	2.76	144.4	23.40	272.6	16.95	285.5	295.92	78.47	.836
	1987	244.2	2.56	161.4	26.07	298.4	18.30	253.3	263.38	86.66	.930
Alaska	1988	124.6	1.48	263.5	41.13	618.0	35.97	99.7	99.85	–	–
	1987	118.0	1.50	199.8	31.26	376.2	22.13	87.2	87.84	–	–
Hawaii	1988	293.6	3.12	–	–	293.6	18.29	–	–	–	–
	1987	345.2	3.66	–	–	345.2	21.53	–	–	–	–
TOTAL	1988	170.7	1.76	152.2	31.99	260.5	16.32	227.7	234.06	72.64	.788
	1987	177.7	1.84	157.8	33.32	304.2	19.04	226.6	233.52	71.11	.768

Source: Adapted from Tables 27 and 28, *Statistical Yearbook*, Edison Electric Institute, 1989.

cents. Still, oil remained the fossil fuel with the highest average cost per million Btu consumed.

For gas, the average cost per million cubic feet remained relatively stable in 1988, increasing only 0.2 percent to 234.06 cents. However, the three Census Divisions that accounted for almost 81 percent of total gas consumption did record an increase in average cost per MCF, as did Alaska. The average cost per million Btu of gas consumed by the electric industry increased to 227.7 cents, up 0.5 percent from 1987's 226.6 cents.

On a per-million-Btu-consumed basis, the average cost of nuclear fuel for 1988 was 72.64 cents, or 2.2 percent more than the 1987 average. The average cost per net kilowatthour was .788 cents, up 2.6 percent from the .768 cents averaged in 1987. Only three Census Divisions posted increases in the average cost per net kilowatthour, but those divisions—East North Central, South Atlantic, and East South Central—accounted for approximately 53 percent of total nuclear generation. (For statistics on fuel consumption, see the Statistical Review column, this issue.)

Contributed by the Statistics Department of Edison Electric Institute.

TECHNOLOGY REVIEW

SOLAR FLARE-UPS INDUCE GEOMAGNETIC DISTURBANCES

Severe geomagnetic disturbances caused by solar flare-ups can adversely impact electric power system security and damage major equipment, as demonstrated by the March 13, 1989, Quebec blackout. This disturbance also resulted in numerous capacitor trip-outs and large voltage fluctuations in New York and New England.

Geomagnetic-induced currents, or GICs have the potential for causing transformer saturation. In addition to the direct impact of saturation on the transformer, the resulting high-magnitude exciting currents can cause voltage distur-

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supported the conclusion that "there was no measurable difference between sales prices . . . regardless of proximity to or distance from the transmission line right-of-way."[10] Another study involving 397 sales yielded similar results.[11] Even though it reviewed defendants' appraisal evidence in detail, the Court did not accept defendants' evidence as "proof that the subject property did not sustain indirect damages."[12] Instead, the Court concluded:

> Because the claimant has failed to sustain either of his burdens of proof as heretofore set forth, the Court cannot make an award for damages caused by 'cancerphobia.'[13]

The *Marcy-South* decision is binding on the other 62 claims with respect to the electric and magnetic fields issue. Its significance is its affirmance of prior New York case law regarding plaintiffs' burden of proof represented by *Miller v. State of New York*, 117 Misc. 2d. 444 and *Niagara Mohawk Power Corporation v. Olin*, 138 A.D. 2d. 940, 526 N.Y.S. 2d. 278 (4th Dept. 1988), and its refusal to adopt the *Daley* standard.

Conclusion

Marcy-South is important in that, unless reversed, it reaffirms New York's position squarely among those jurisdictions holding that landowners must both: (1) prove a potential purchaser has *reasonable* grounds for fear that power lines cause health problems, and (2) demonstrate diminution in market value by actual proof from the real estate market, in order to recover consequential damages attributable to claimed adverse EMF health effects in transmission line cases.

It remains to be seen whether the *Marcy-South* or the *Daley* rule regarding the standard of proof for collecting damages for fear of health effects associated with EMF will become the majority rule. It is important to note that in *Daley*, San Diego Gas & Electric did not have an opportunity to present expert witnesses on the issue of the existence of potential health effects from EMF. Most jurisdictions have allowed testimony on the issue. However, until scientific research can disprove claims of adverse health effects associated with EMF exposure, it is likely, even despite the *Marcy-South* victory, that electric utilities will continue to face litigation involving EMF health effects issues.

Contributed by W. Edward Poe, Jr., Deputy General Counsel at Duke Power Company, and Melinda J. Horgan, an associate at Donelan, Cleary, Wood & Maser, P.C.

Notes

1. *Zappavigna v. State of New York Power Authority of the State of New York*, Claim No. 74085, N.Y. Ct. of Claims (September 29, 1989), a/k/a "Marcy-South."
2. *Id.* at mimeo 25.
3. *Id.* at mimeo 26.
4. For previous litigation regarding this line, see *PASNY v. Potocnik, et al.*, 508 N.Y.S. 2d. 665 (1986) and *Delaney v. PSC of New York*, 507 N.Y.S. 2d. 471 (1986).
5. *San Diego Gas & Electric v. Daley*, 205 Cal. App. 3d. 1339 (1988).
6. *Zappavigna* at mimeo 11.
7. *Id.* at mimeo 12.
8. *Id.* at mimeo 25.
9. *Id.* at mimeo 26.
10. *Id.* at mimeo 27.
11. *Id.* at mimeo 28.
12. *Id.* at mimeo 31.
13. *Id.*

STATISTICAL REVIEW

1988 FUEL USE

Utilities' electric generation from all energy sources grew by 5.0 percent in 1988, up from 2,572,127 million kilowatthours in 1987 to 2,701,624 million kilowatthours. Generation by fossil fuels increased 4.5 percent while generation by nuclear fuel increased by 16.2 percent.

Table 1 shows the related 1988 fuel consumption data for the nine Census Divisions and for Alaska and Hawaii. The source for the table is *Statistics on Fuel Used to Generate Electricity by the Electric Utility Industry*, a report published annually by Edison Electric Institute. The fossil fuel data captures 98.5 percent of the generation reported in DOE/EIA's *Monthly Power Plant Report*. The nuclear statistics repre-

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Table 1
1988 Fuel Use: Electric Utility Industry

	Consumption								Generation		
	Coal—In Thousands of Tons			Oil—In Thousands of Barrels			Gas—In Millions of Cubic Feet			Nuclear—GWh	
	1988	1987	% Chg.	1988	1987	% Chg.	1988	1987	% Chg.	1988	1987	% Chg.
New England	6,341	6,218	2.0	62,064	53,486	16.0	21,152	52,569	(59.8)	32,505	29,370	10.7
Middle Atlantic	55,066	52,108	5.7	88,201	71,266	23.8	200,094	241,122	(17.0)	84,550	79,519	6.3
East North Central	162,620	161,100	0.9	6,051	5,341	13.3	23,260	18,186	27.9	106,865	80,390	32.9
West North Central	98,643	88,755	11.1	714	444	60.8	26,960	22,196	21.5	37,857	35,405	6.9
South Atlantic	128,123	125,146	2.4	57,605	46,982	22.6	149,148	198,298	(24.8)	144,007	130,424	10.4
East South Central	77,589	74,439	4.2	1,755	615	185.4	34,156	41,041	(16.8)	26,513	18,857	40.6
West South Central	113,757	106,894	6.4	1,993	1,034	92.7	1,474,687	1,506,104	(2.1)	25,470	23,693	7.5
Mountain	91,973	82,909	10.9	1,290	789	63.5	69,107	57,938	19.3	23,600	13,632	73.1
Pacific	5,723	5,192	10.2	12,017	3,364	257.2	541,942	615,323	(11.9)	43,237	40,262	7.4
AK & HI	126	271	(53.5)	12,809	12,570	1.9	31,920	31,446	1.5			
TOTAL	739,965	703,632	5.3	244,499	195,891	24.8	2,572,423	2,784,224	(7.6)	524,603	451,551	16.2

sent coverage of all utilities. (For statistics on 1988 fuel costs, see the Financial Review column, this issue.)

Of the fossil fuels, oil experienced the largest increase in electric generation, jumping to 144,278 million kilowatthours, a 26.2 percent increase over 1987. Oil consumption for generation grew by 24.8 percent, from 195,891 thousand barrels in 1987 to 244,499 thousand barrels. The Pacific Division saw the largest percentage increase (257.2 percent), and the Middle Atlantic Division saw the largest absolute increase (16,935 thousand barrels).

Electricity generation by coal grew from 1,447,494 million kilowatthours in 1987 to 1,518,416 million kilowatthours in 1988, a 4.9 percent increase. The addition of two medium-sized coal-fired units helped edge coal's share of total fossil fuel generation up from 79.1 to 79.5 percent. The amount of coal consumed for generation rose 5.3 percent over the previous year's total. Each Census Division experienced an increase; only Alaska and Hawaii saw a decrease.

Generation of electricity by a natural gas decreased over the same period, dropping from 267,170 million kilowatthours to 247,789 million kilowatthours, a decrease of 7.3 percent. The fuel's share of total fossil fuel generation fell from 14.6 to 13.0 percent. The consumption of gas for electric generation decreased 7.6 percent to 2,572,426 million cubic feet, down from 2,784,224 million cubic feet in 1987. Six of the Census Divisions experienced decreases while the remaining three saw increases, as did Alaska and Hawaii.

In 1988 electric generation by nuclear fuel represented 19.5 percent of total generation. It increased from 451,551 gigawatthours in 1987 to 524,603 gigawatthours in 1988, a 16.2 percent increase. The addition of five new nuclear plants, increased generation from existing plants, and the return to commercial operation of an idled plant were responsible for the growth. All Census Divisions experienced an increase in generation by nuclear fuel, with the largest percentage increase occurring in the Mountain Division (73.1 percent) and the largest absolute increase occurring in the East North Central Division (26,475 gigawatthours.)

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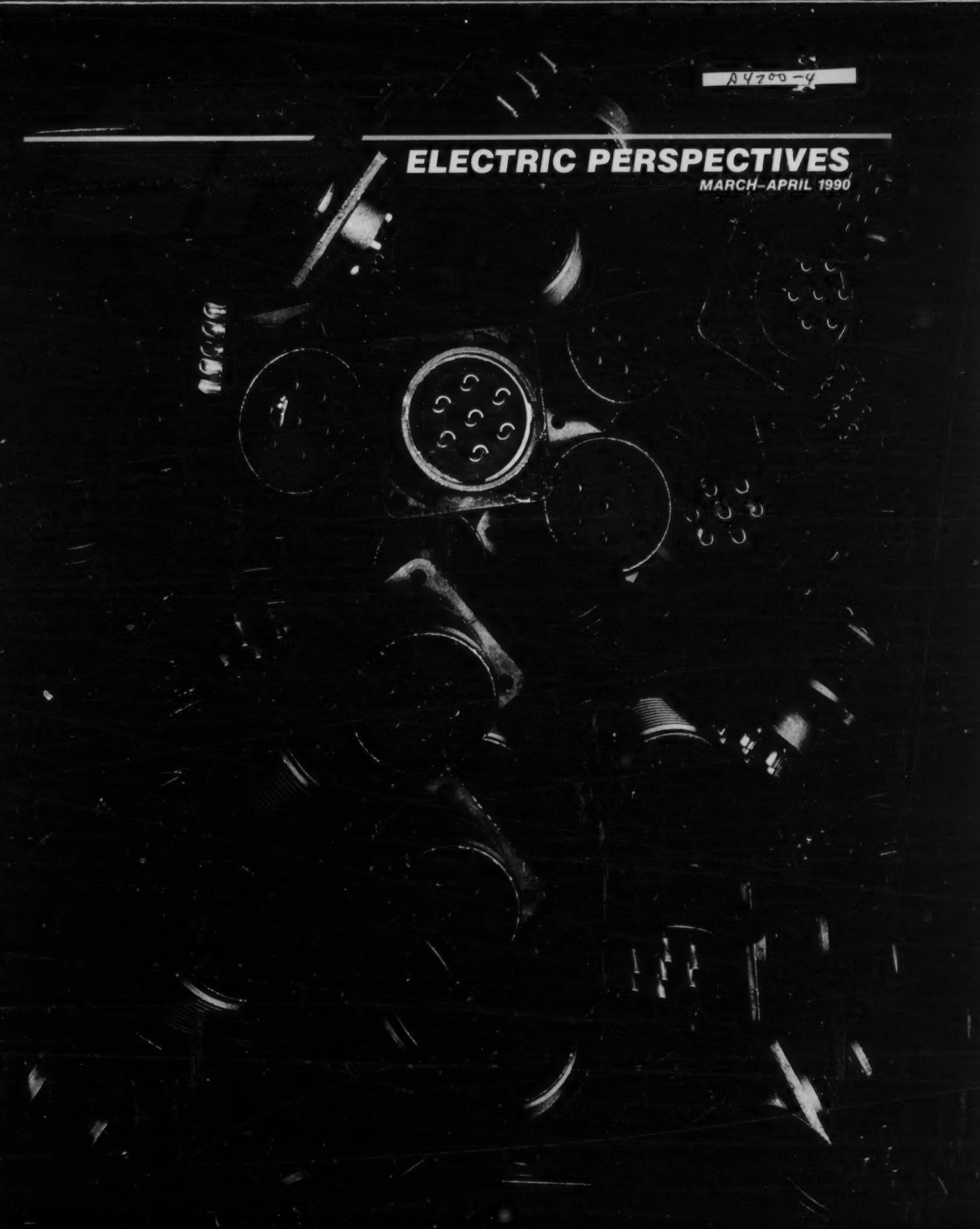
MARCH–APRIL 1990



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Cover photo by Rene Sheret/Folio, Inc.

Advanced Technology And Long-Range Energy Requirements

Deeply embedded in visions about our future use of advanced technologies are far-reaching implications for estimating the Nation's future energy demand.

Advances in basic science and engineering promise a continuing stream of changes in the way we work and live in the 1990s and beyond. Already, a rapidly growing range of advanced materials is giving rise to a move away from conventional metals. Sophisticated sensors, micro-processors, and other electronic devices are creating a path for numerous process and management innovations on the factory floor. Revolutions in medicine and agriculture, based on recent breakthroughs in genetics and the emerging biotechnology industry, are yielding new products and processes. And, an ever increasing number of products and services closely linked to computers, telecommunications, and other advanced electronic information technologies is reaching center stage in all sectors of the economy.

Deeply embedded in visions about our future use of these and similar technologies are far-reaching implications for estimating the Nation's future energy requirements. While much is already discernible among the innovations that will drive new applications in the 1990s, uncertainty prevails about the rate at which new technologies will penetrate our homes, factories, offices, and shops.

This limited knowledge of the pace of technology adoption forces anyone undertaking a longer-term assessment of U.S. energy requirements to consider a range of outcomes, which is the exercise presented in this article. It is intended to complement the outlook of EEI's Electricity Futures Project, which was completed in late 1988. (A summary report of the project's findings appears in the March–April 1989 issue of *Electric Perspectives*.) In this follow-up work, important technology trends are considered for each of the major electric customer classes: households, commerce, and industry. Particular emphasis is given to developments influencing the efficiencies attainable in energy end uses and the choices available to customers.

This article, an outgrowth of Edison Electric Institute's Electricity Futures Project, is the second of a pair exploring various forces that will affect energy demand over the next 25 years. The first, published in the January-February 1990 issue, considered the energy impacts of alternatives regarding the composition of the economy and population and GNP growth rates.

The Residential Sector

An observer of the Nation's housing landscape in the year 2015 is unlikely to be overwhelmed by any differences in external appearance or configuration from what we see today. But what he will find "between the walls" and inside the dwelling is surely another story. The greatest potential for technological change in this sector arises from expanded capabilities for communications within and out of the home, the automation of household tasks, improved building design and materials, and the availability of more sophisticated household appliances and equipment. Nearly all of these developments have significant implications for household energy consumption.

Around 90 million occupied units account for most of the Nation's current residential housing stock. Some 62 percent of these are single-family detached homes; multi-unit buildings account for another 33 percent, and mobile homes for 5 percent. In the period since 1970, yearly additions to the housing stock have averaged around 1.7 million units, of which a little less than two thirds have been single-family detached homes. Postwar construction is now predominant, with almost 70 percent of the housing stock built since 1950.

Over the next 25 years, household formation can be expected to outpace population growth as the number of occupants per dwelling unit continues to decline, a result of the population's growing affluence,

Mark Boroush and Peter Stern are with The Futures Group, a Glastonbury, Connecticut, research firm.

Rene Sherel / Foto, Inc.

mobility, and independence. Hence, roughly 40 million new residential units should be added to the Nation's housing stock over the next 25 years. If current trends hold, around two thirds of them will be of single-family design. Over the same period, some replacement of existing buildings can also be expected—perhaps as many as 5 to 7 million units by the year 2015, with many of those torn down being multiple-family and apartment structures built prior to 1940. Thus, the country's total housing stock in 2015 should stand at about 125 million units, with about the same distribution among building types as we have at present. Roughly a third of those dwellings will have been built after 1990, providing a major opportunity to achieve the substantial efficiency gains afforded by energy-conscious building designs. In addition, most older structures, being at least of postwar vintage, should be reasonably suitable for efficiency retrofits, yielding worthwhile economic benefits in an environment of gradually rising energy costs.

Advances in construction methods and materials are key to achieving technology changes affecting the home. Designing residential structures for greatly improved thermal integrity is possible today, and such requirements are increasingly incorporated into local building codes. Widened walls for more insulation, non-heat conducting beaming, multi-glazed windows, and efficient heat exchange—all utilizing existing techniques—can provide up to a 70 percent reduction, according to recent estimates, in the total annual energy requirements of the typical new residential home, when compared to current use levels.[1] Advances in thin film coatings for multi-glazed windows, along with micro-coated control systems, hold the near-term promise of "tuneable" windows capable of transmitting solar energy during the winter and reflecting heat during the summer. Careful site planning, landscaping, and building orientation also can reduce a dwelling's fuel requirement by exploiting opportunities for daylighting and passive solar heating.

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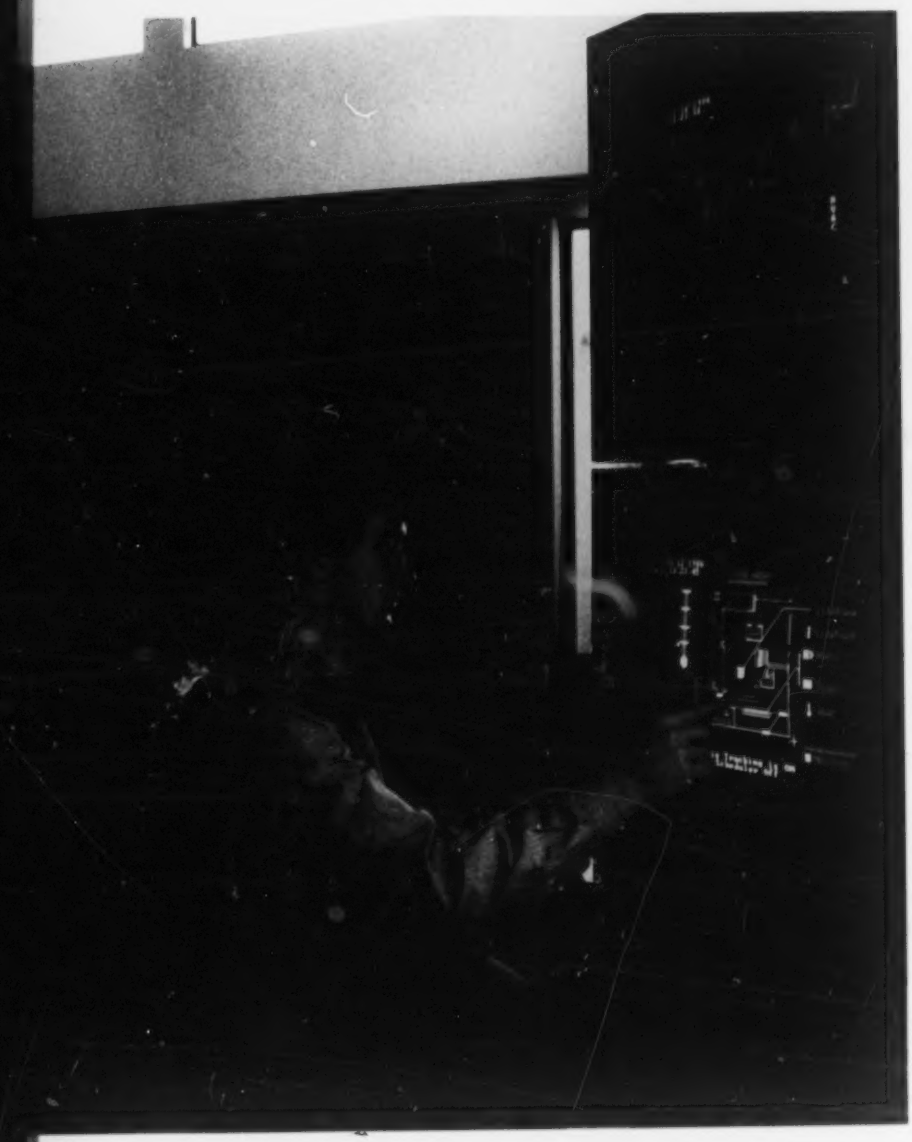
All these developments in building design and construction are a commercial reality now, well along the development curve leading to economies of scale that can support mass production and justify new marketing programs.[2] Some features are best suited to new homes—

About a third of the country's housing stock in the year 2015 will have been built after 1990.



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"Smart house" technologies, many of which are commercially available, will have a growing influence on the amount and kind of energy households require.

which as noted, will represent a sizable part of the country's housing stock over the next several decades. However, the market for retrofits in existing homes is also on the upswing—providing refittings with advanced window designs, add-on construction incorporating passive solar heating, installation of air infiltration barriers, and improved insulation during residing. Comfort and convenience considerations, the economic benefits to be reaped, and public policy all promise to stimulate both of these markets in the years ahead.

Advancing "smart house" technologies represent a second key area of technology change affecting residential customers, their homes, and their energy requirements. The lifestyles and work habits of the 1990s will heighten people's desire to automate household tasks and to gain wider access to the rapidly expanding array of information resources available through computers and telecommunication links (e.g., instructional resources, banking in the home, travel scheduling, electronic shopping). Changing job demands, dual income family pressures, rising real incomes, consumer sophistication, and the desire for increased recreational opportunities in and around the home will push the adoption of smart house technologies—a good example of customer-driven market opportunities for the electric industry.

Many smart house functions are under development now. For new homes, sophisticated cables and "universal" room wall outlets will be able to integrate the distribution of electricity with all audio/video data signals throughout the house; consumers will have considerable flexibility in mixing the available functions on a room-by-room basis. Intelligent "plug-in" devices (e.g., smart thermostats, automated drape and illumination controls, security devices) and household appliances interconnected through this network will provide a range of services, such as comprehensive home energy management (HVAC, lighting, appliances), home surveillance, and electronic access to a full spectrum of broadband communications options. Although options in older homes will be subject to some constraints, emerging communication standards coupled with a new generation of intelligent appliances promise a significant menu of smart house options, including customer-controlled energy management, for retrofit installations.

A third and sometimes related area of technology advancements is the gain in energy efficiency anticipated in the 1990s for many household appliances and equipment. New generations of space heating equipment (e.g., advanced electric heat pumps with integrated water heating) are capable of providing

refined performance and self-intelligent control while achieving significant gains in energy efficiency. Similar improvements are being built into air conditioning units, cooking ranges, clothes dryers, refrigerators, and freezers. In the area of lighting, a wide range of screw-in fluorescent lamps is becoming available for consumers to displace the shorter life and lower energy efficiencies of conventional incandescent bulbs. And soon, advances in photocells, microprocessors, and plastic "light pipes" utilizing holographic coatings will give rise to additional lighting economies by automatically blending daylighting and artificial illumination to meet the consumer's daily cycle of needs.

Engineering studies of these emerging technology options conclude that the aggressive and creative application of advanced technology can reduce the total energy consumption of a new home by a factor of two or more.[3] Table 1, which lists the prospects for efficiency improvements among selected household appliances and equipment, typifies the level of energy savings viewed as achievable in the 1990s. The last column indicates the dramatic improvements that can be attained if market barriers are successfully overcome.

Of course, less dramatic gains are to be expected in existing homes where older design features impose some limits on practicable improvements. But the technical state of the art for retrofits is certain to be extended as the occupants of the older housing stock seek the amenities built into new homes.

What is less certain, however, is how rapidly these new technologies will penetrate the housing market. The availability of "technologically superior mousetraps" is relatively easy to foresee; predicting how rapidly residents will actually buy and use them is a more difficult question.

The influences—both positive and negative—on the rate of technology acceptance are many. The Nation's continued high turnover rate in home occupancy imposes, in practice, some very tight, near-term "payback" thresholds on energy saving features whose economic benefits stand out only when cal-

Table 1

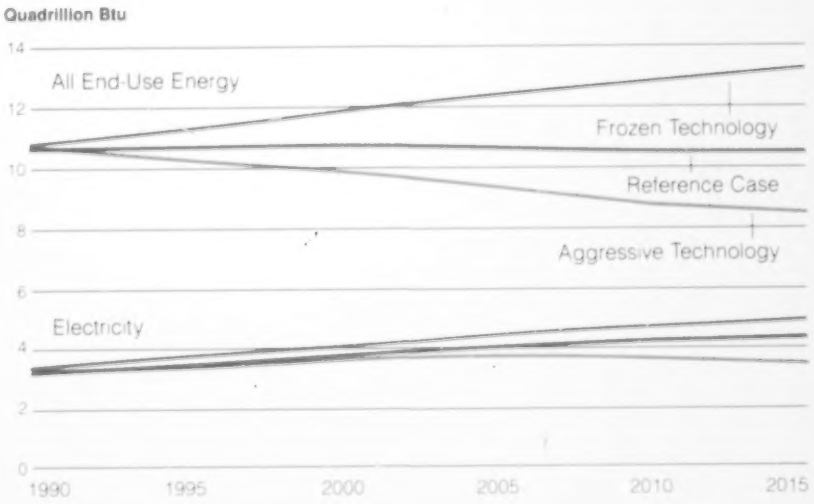
Energy Efficiency of Residential Appliances
Kilowatthours per year

	Avg. in 1985 Housing Stock	In Typical New Homes, 1985	Best Available Tech, 1985	Advanced Tech in the 1990's
Refrigerator	1,500	1,100	750	200-400
Freezer	1,100	800	500	150-250
Central air conditioning	3,600	2,900	1,800	900-1,200
Room air conditioning	900	750	500	300-400
Electric water heating	4,000	3,500	1,600	1,000-1,500
Electric range	800	750	700	400-500
Electric clothes dryer	1,000	900	800	250-500
Lighting	1,000	1,000	650	350-500

Source: U.S. Office of Technology Assessment, *Technology and the American Economic Transition*, May 1988, p.112

Figure 1

Residential Sector—End-Use Energy



SOURCE: Electricity Futures Project projections, 1989

culated on a lifecycle rather than a first-cost basis. Furthermore, decisions regarding major energy-using equipment for a new home are typically made by builders and developers whose cost considerations are not the same as those of the future resident facing monthly energy bills. Replacement cycles for major household appliances are typically of 10 to 15 years' duration, as replacement decisions are often delayed by other domestic priorities. Consumer acceptance of the comfort and control of the automated house will not happen overnight because many features of the information technology revolution have yet to become familiar for commonplace tasks.

The stimulus of public policy is also critical. Will the newly imposed federal standards governing appliance efficiencies be made more stringent in the years ahead or will compliance deadlines be extended? Will local building codes incorporate more requirements for energy performance standards in new construction? Will required or voluntary utility initiatives embodied in demand-side management be effective in speeding customer adoption?

Clearly, the industry has a critical need for market research and evaluation in this area of customer behavior. Meanwhile, it is prudent to work with a range of possible outcomes as we forecast the demand for energy over the next 25 years. Figure 1 portrays three combinations of market/policy trends to illustrate how the pace of new technology penetration will influence the long-range requirements for electricity and total end-use energy in the residential sector. The Electricity Futures Project's Reference Case assumes essentially a continuation of the public policies of the 1980s and of the decade's decision-making environment, which was highly sensitive to perceived fuel price trends.

Table 2

Residential Sector—Characteristics of Alternative Scenarios

	1988	2000	2015
Number of Households			
Millions	92.0	110.2	124.4
Additions to Housing Stock			
Cumulative after 1988, million units	—	21	39
Average End-Use Energy Requirements			
Million Btu per household, annually			
Frozen technology	106.7	106.4	104.1
Reference case	106.7	95.6	83.7
Aggressive technology adoption	106.7	88.8	67.9
Average Electricity Use			
Million Btu per household, annually			
Frozen technology	32.1	35.6	37.5
Reference case	32.1	34.4	33.4
Aggressive technology adoption	32.1	32.4	27.8
Electricity's Share of End-Use Energy			
Frozen technology	30.1%	33.5%	36.0%
Reference case	30.1%	36.0%	39.9%
Aggressive new technology adoption	30.1%	36.5%	40.9%

The first alternative is based on a "go slow" case in which current technology is "frozen" in time. Over the 25-year forecast horizon, it posits no penetration of significant innovations that would alter energy consumption patterns in the home. The second alternative reflects an aggressive view of the pace of technological innovation, given the expected turnover in housing stock and the "experience curve" effects typically associated with market acceptance of new technology. This second world is the kind that could emerge in a setting of higher energy prices and public policy that actively promotes energy efficiency improvements—whether motivated by environmental, competitive, and/or national security concerns.

Each of these projections accounts for differences in the way the major residential end uses (space heating, water heating, refrigeration, etc.) are likely to be affected by evolving technology. The potential for technology penetration in new vs. existing homes is also considered. Both alternative scenarios retain the basic economic and social assumptions embedded in the Reference Case (including a real GNP growth rate of about 2.5 percent annually in the 1990s and somewhat slower in the 2000–2015 pe-

Computer-aided diagnostic equipment like this magnetic resonance imaging system typifies the way in which advanced technologies are penetrating the commercial sector.

riod; a slowdown in population increase throughout the 25-year outlook period; and shifts in the Nation's mix of delivered goods and services toward technologically sophisticated products and more technology-supported services).

As shown in Table 2, the spread between the high and low projections for total end-use energy is indeed considerable. In the "frozen" technology scenario, total end-use energy requirements per household are just about the same in 2015 as at present. In the "aggressive" technology scenario, the efficiency gains from a steady penetration of advanced technology result in about a 36 percent reduction from 1988 household requirements. The less aggressive Reference Case sees a 22 percent reduction.

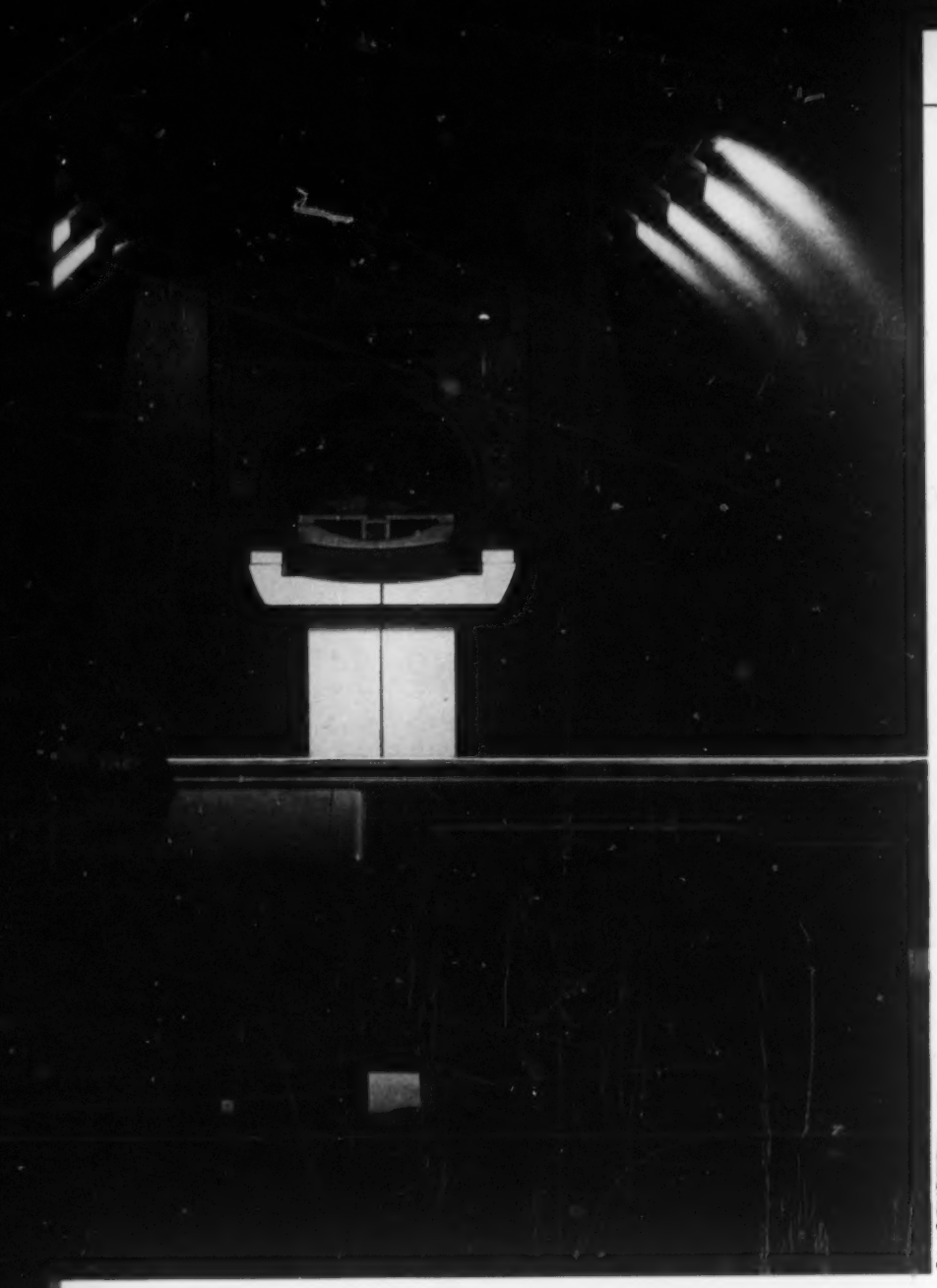
The forecast range for the residential sector's future electricity requirements is less pronounced than the one charted for total end-use energy. Technology-driven efficiency improvements (which tend to lower electricity requirements) are partially offset both by new applications for electricity (new smart house and labor-saving applications) and by a shift toward greater electrification in the end-use categories where electricity traditionally competes with other fuels (space heating, water heating, cooking). Still, all three projections reflect a growth in demand for electricity in the home.

The Commercial Sector

The commercial sector spans a diverse group of economic activities, extending from retail and wholesale trade to health care, education, banking and finance, law, advertising, design, entertainment, the arts, and many personal and business services. This sector now plays a major and growing role in the overall economy, with services-producing industries accounting for about 70 percent of both GNP and total employment.

Within the commercial sector, advanced technology serves as a potent force for change. Operations, costs, and even the scope and scale of business activities are undergoing profound changes as the world of commerce embraces new computers, communications links, inventory control and distribution systems, sophisticated measurement devices, and other manifestations of advanced technology.

Just a few illustrations should suffice to outline the explosion of technology in this sector. In education, "mixed media" personal computers with integrated text, images, and sound are expanding the possibilities of programmed instruction and helping teachers accommodate differences among students' learning styles and abilities. In healthcare, large-scale medical history and therapeutic databases are



Robert Rathe / Foto, Inc.

being coupled with computer-aided diagnostic systems to assist physicians in the management of patient care and to support administrators with more efficient billing and cost-monitoring procedures. In insurance, extensive electronic databases and national communications linkages are being used to speed the claims process, to streamline sales and distribution channels, and to shift office locations and labor needs in advantageous ways. In advertising, advanced printing techniques capable of tailoring advertising copy to more segmented preferences are being utilized along with an expanding array of media to target ever smaller consumer market niches. In retailing, computers, optical scanners, and other point-of-sale electronic devices are streamlining and automating marketing, credit, and distribution functions.

Of course, these electricity-using technologies are advancing simultaneously with other technologies designed to minimize total energy costs. As we enter the 1990s, the major advances in these energy-saving technologies mirror those at work in the residential sector—new designs and materials for construction, new generations of appliances and equipment, and automated systems for managing a building's total energy requirements.

At present, the Nation's stock of commercial structures totals 4.2 million buildings of varied types, including urban high-rise offices, low-rise suburban offices, single office medical/professional buildings, hospital complexes, libraries, university laboratories, hotels, shopping malls, warehouses, and the like. Among these, both the role and usage level of basic energy end-use categories vary widely.

Changes in the way these conventional commercial buildings are designed, along with the use of improved construction materials, can yield major advances in energy efficiencies. For example, new envelope designs can accommodate materials with high R-values (composites or foams with R-30 to R-60 ratings, for example). Other designs offer savings by using a building's mass and/or specifically selected reservoir materials to permit thermal energy to be stored and shifted. Similarly, some building designs exploit "passive" energy resources by capturing available daylight and the "free heat" generated by people, lighting, and appliances, thereby reducing energy requirements. Energy transfers through windows can also be reduced, principally by eliminating the now common floor-to-ceiling window designs and by replacing conventional single-glazed glass with double-glazed, low-emissivity glass. Switchable emissivity windows, which will soon be available, promise even greater savings. The application of such technologies yields additional benefits by allowing heating and cooling equipment—much of which is currently

oversized to cope with the thermal losses and heat build-up caused by poor materials and designs—to be downsized.

Improving energy efficiencies in end-use equipment is a second area of technology change that will have an important effect on future requirements in the commercial sector. The technical potential for residential energy savings outlined in Table 1 is also applicable to commercial-scale equipment used for space conditioning, water heating, refrigeration and freezing, and, especially, lighting. [For a description of some of the latest advancements in lighting technology, see page 39.] Some of the gains may involve fuel substitution as well as fuel-use reductions.[4]

Finally, energy management systems for the home have a direct parallel in the "intelligent" commercial building. Micro-processors, sensors, and local area networking can automate and optimize the operation of a building's HVAC, hot water, and lighting equipment according to specific daily and seasonal needs. As windows with switchable emissivity penetrate the market, they too can be controlled automatically.

Of course, in all of these areas, the overall energy gains derived will vary from building to building according to their type and age and the range of options already adopted.[5] Still, based on a combination of theory and practical experience, experts indicate that a three-fold or greater reduction in energy requirements per square foot is achievable, even in buildings constructed a decade ago.[6]

According to estimates developed by the Electricity Futures Project, new construction could account for as much as 40 percent of the commercial building stock in place by 2015. Most of the older stock will be of post-1950 vintage. Thus, there would seem to be a vast market for the new designs, materials, and equipment that can enhance energy efficiencies in both new and existing buildings. Again, the greatest uncertainty is not a question of technical know-how but rather of market penetration.

The obstacles to the adoption of these energy-saving technologies are generally the same as those discussed for the residential sector. Cost considerations vary according to several factors: is the facility designed for single or multiple tenancy? is it built to the future occupants' specifications, or is it built as a speculative investment venture? which is valued more, keeping future operating and maintenance costs low or minimizing initial costs? In fact, geography, climate, site location, interest rate, amenities, and prestige are such important considerations in a commercial building's financial success that it is difficult to isolate energy as a key decision-making factor.

Nevertheless, just as in the residential sector, construction firms are becoming increasingly sophisticated about the value of reliable energy service, the incentives offered by utilities to push energy-efficient design, and the technology and controls available to optimize heating/cooling levels within the building envelope. Moreover, the current slowdown in the rate of commercial construction—brought about by the over-building of the mid-1980s, high vacancy rates, and the now slackening pace of economic expansion—may well allow successful energy applications to gain even wider acceptance before the next building cycle gets underway.

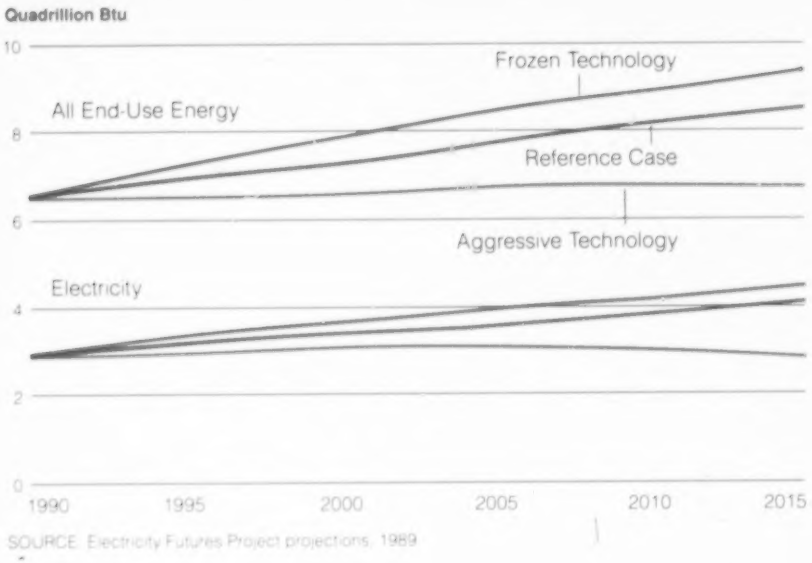
Figure 2 portrays the implications for energy use of different combinations of advanced technology availability and penetration into the commercial sector. Once again, the Reference Case projection is contrasted with a pair of alternative scenarios—one making aggressive assumptions about the pace of new technology adoption over the next 25 years, the other assuming a technology "freeze." The economic outlook developed for the Reference Case is retained for both alternatives.

Figure 2 reveals a substantial spread between the high and low scenarios of total end-use energy. The "frozen" technology case basically maintains the 1988 level of energy demand per square foot of commercial floorspace throughout the 25-year forecast horizon (see Table 3). As a result, total demand for energy grows essentially at the forecasted pace of the sector's overall economic expansion. In the "aggressive" technology case, efficiency gains from the steady penetration of advanced technology reduce the sector's energy intensity by almost 30 percent between 1988 and 2015, compared to a projected decline of only 10 percent in the Reference Case. The greatest opportunities for efficiency gains are projected to be achieved with water heating, refrigeration, lighting, and, especially, space heating and cooling. Together these end uses account for more than 80 percent of the average energy requirements in existing commercial buildings.

For electricity, the spread in the demand forecasts is also quite large. But the explanation of the differences is more complex, due to several competing trends: increasing electrification in such competitive end uses as space heating and water heating, improving efficiencies across most end-use technologies, and the accelerating pace at which

Figure 2

Commercial Sector—End-Use Energy



SOURCE: Electricity Futures Project projections, 1989

space-age electronic equipment is installed in commercial structures.

Electricity requirements in the "frozen" technology case are modestly lower than in the Reference Case throughout the forecast horizon. This is so because the Reference Case incorporates a fair amount of efficiency improvement across the end uses that typify the commercial market. Also, by assuming a technology "freeze," we have in effect arrested the trend towards greater electrification which the Reference Case reflects. By contrast, the electricity requirements of the "aggressive" technology scenario are well below those of the Reference Case—some 20 percent lower by 2015. Here the rapid penetration of technologies that improve end-use efficiency more than offsets the increases in use anticipated from greater electrification and the addition of sophisticated electronic equipment. It should also be noted that in all three cases other fuels are expected to make some inroads into areas where electricity has traditionally been dominant.

The Industrial Sector

Much has been said about the emerging service orientation of the Nation's economy and the apparent eclipse of the industrial sector which, for so long, has been the driver of the country's economic growth. Historical statistics clearly document the sharply declining contributions of agriculture, mining, and construction to GNP. But manufacturing has retained a fairly stable share of output for many decades, and there is little reason to expect any fundamental changes in this pattern. The nature of manufacturing operations, however, is changing in significant ways, and these changes have important implications for the industrial sector's longer-term energy requirements.

One of the notable characteristics of U.S. manufacturing is the fact that the industries producing conventional bulk materials like pulp and paper, industrial chemicals, refined petroleum products, glass, cement, clay, steel, and other unfabricated metals are now among the more mature, hence slow-growing, segments of the economy. This phenomenon is due to saturated markets for large consumer durables, to emerging preferences for products with low materials densities and sleeker designs, to the "new materials" renaissance (e.g., new polymers, composites), and to managers' rising concern over recycling needs and the disposal of industrial wastes. Yet bulk materials production is typically more energy intensive per dollar of output by an order of magnitude than other manufacturing classifications are. Consequently, the accelerating shift in the composition of manufacturing output to higher value-added specialty products foreshadows a trend to lower overall energy requirements.

When it comes to the younger, expanding manufacturing classifications, including such ascending stars as aerospace, electronics, advanced materials, specialized chemicals and metals, and non-electrical machinery, pressures are growing to streamline operations and refurbish productive capabilities to meet the ever keener competition in the global market. Advanced technology is now helping to create the "factories of the future" in many of these growth industries. That technology includes sensors and electronic processing for the automated control and optimization of production processes; computer work stations for product design and planning; advanced machining tools, robots, and shop-floor layouts that support flexible manufacturing operations.[7]

Table 3

Commercial Sector—Characteristics of Alternative Scenarios

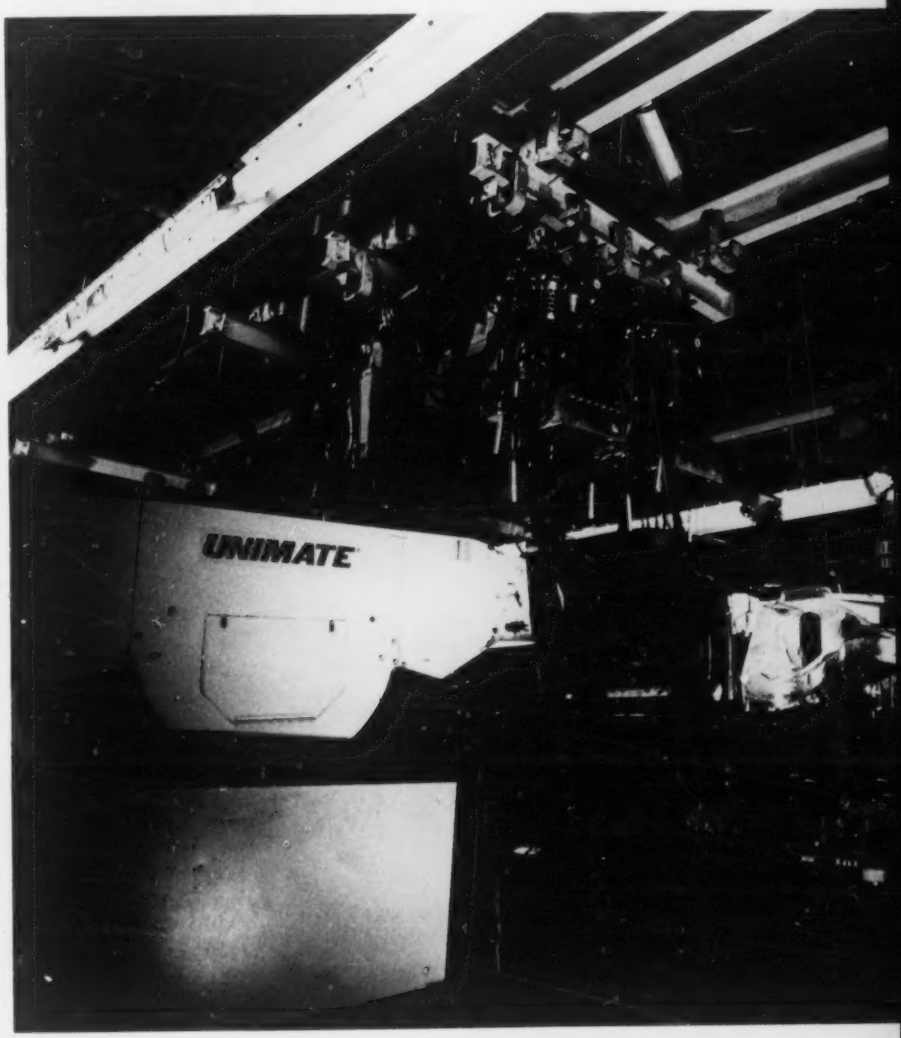
	1988	2000	2015
Total Floorspace			
Billions of square feet	57.0	71.9	2015
Additions to Building stock			
Cumulative after 1988, billion square feet	—	17	33
Average End-Use Energy Requirements			
Thousand Btu per square foot, annually			
Frozen technology	111.3	110.2	110.3
Reference case	111.3	103.2	98.8
Aggressive technology adoption	111.3	91.9	79.2
Average Electricity Use			
Thousand Btu per square foot, annually			
Frozen technology	47.3	48.1	48.1
Reference case	47.3	51.2	50.6
Aggressive technology adoption	47.3	44.9	37.5
Electricity's Share of End-Use Energy			
Frozen technology	42.5%	43.7%	43.6%
Reference case	42.5%	49.7%	51.3%
Aggressive new technology adoption	42.5%	48.8%	47.3%

Competition-driven concerns regarding energy's contribution to manufacturing costs will speed the adoption of a host of other new technologies with greatly improved end-use efficiencies. A new generation of electric motors offering efficiency gains of around 5–10 percent is now being commercialized; they should have wide application. Likewise, electronic adjustable speed drives are becoming available; they promise efficiency gains averaging perhaps 20 percent through the better adjustment of motor speed to cycling need. Environmental protection policies, on the other hand, could well require more precise and comprehensive process control operations, with even greater reliance on motors for "clean up" purposes. But on balance, the combined effects of improved designs and drives should result in a net reduction in energy requirements for the motor component of industrial energy use.

Energy efficiency gains can also be achieved by the application of advanced technology to many process heating operations, the end-use category that accounts for the lion's share of the entire industrial sector's energy requirements. Advanced membranes, for example, are leading to new separation processes, many of which are more effective than conventional processes utilizing energy-intensive distillation. With electricity powering such advanced process technologies as laser cutting, electrical discharge machining, microwave heating and drying, plasma processing, and electrolytic separations, new opportunities are being created for revolutionary improvements in processing and control, together with an overall lowering of energy requirements. The increased use of such advanced materials as plastics, composites, and ceramics in many products will bring about a considerable reduction in the heat flows now necessary to mold and shape conventional metals.

In addition, energy management is rapidly becoming one of the elements of a comprehensive system for automating control of factory operations. Together with process designs that can utilize waste heat flows more efficiently, automation will contribute to greater economies in the industrial sector's use of energy. And, in parallel with developments in the residential and commercial sectors, industry is in the process of installing advanced equipment and controls for HVAC, lighting, and other customized process or assembly-line operations.

Despite all this shining promise of improving energy efficiency, however, it is hard to generalize about the impact these technology enhancements will have across the manufacturing spectrum. The considerable differences in production processes from one industry segment to another and in the mix of energy requirements from plant to plant, even within the same industrial group, complicate the picture considerably. Nonetheless, taking into consideration both the effects of the changing mix of industrial output and the adoption of new process technology, industry experts believe it is possible over the next several decades to match or perhaps to exceed the roughly 30 percent im-



Electricity-based advanced technologies are rejuvenating American manufacturing.

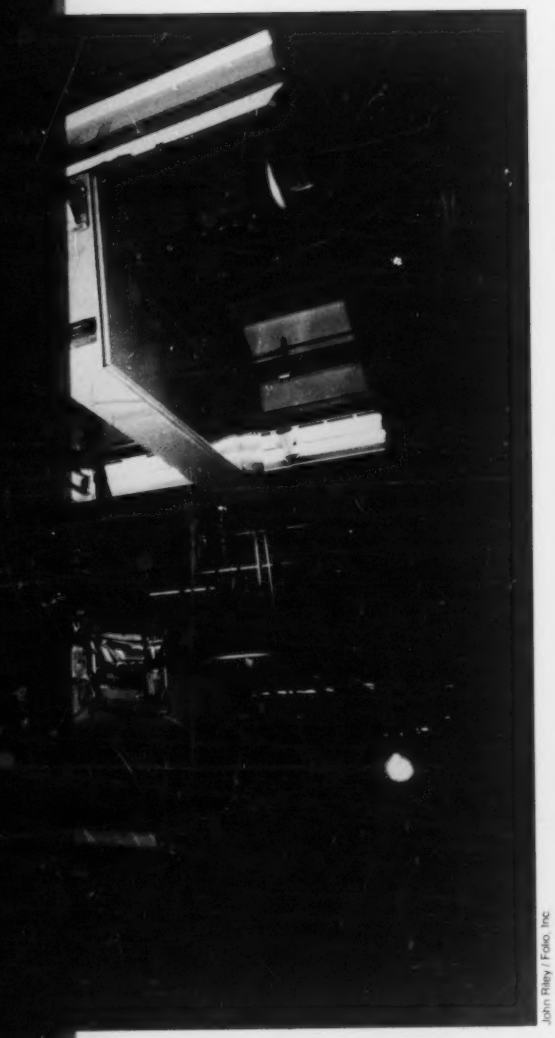
provement in industrial energy intensity attained during the 1975–85 decade.[8]

Electricity's prospects in this end-use sector are also subject to a mix of competing forces. Electricity is clearly the central powering element in the ongoing automation, reorganization, and introduction of more flexible work flows, all of which are rejuvenating the Nation's manufacturing sector. But the significant improvements to current applications of electricity resulting from the new technology in motors, drives, HVAC, lighting, etc., along with the better rationalization of all energy uses due to automated management, inevitably exert a downward effect upon demand. The growth rate of industrial electricity demand over the next several decades will, no doubt, depend on just which industries are most successful in the marketplace and how fast the more efficient end-use technologies are adopted. Important, too, will be the pace at which advanced electrotechnologies penetrate into the process heating arena.

Figure 3 portrays a pair of energy scenarios which stand in contrast to the projections of the Reference Case. Again, the focus is on the pace of new technology penetration. As before, the economic assumptions driving the Reference Case also underlie these alternative scenarios, including the significant structural shift of the Nation's industrial output toward the comparatively less energy-intensive but higher value-added manufacturing classifications.

There is a considerable spread between the high and the low projections in Figure 3 for all end-use energy. The "frozen" technology scenario projects total energy requirements to be nearly 20 percent higher in 2015 than those of the Reference Case. At the same time, the average energy requirement per real dollar of output for the industrial sector as a whole declines marginally over the forecast horizon, chiefly as a result of the previously mentioned shifting composition of output. (See Table 4). In contrast, the "aggressive" technology scenario projects significant additional gains in the efficiency of energy use. As a result, the industrial sector's total energy consumption is about 10 percent lower in 2015 than the level projected by the Reference Case. The reasons for this further improvement are many, and they are different for each industry group. The basic driving force, however, is the accelerating penetration of efficiency-improving technology in motors, electrolytic devices, HVAC, lighting, and process heating.

As to future electricity requirements, the projection results shown in Figure 3 are surprising at first blush. The assumptions for the



John Riley / Foto, Inc.

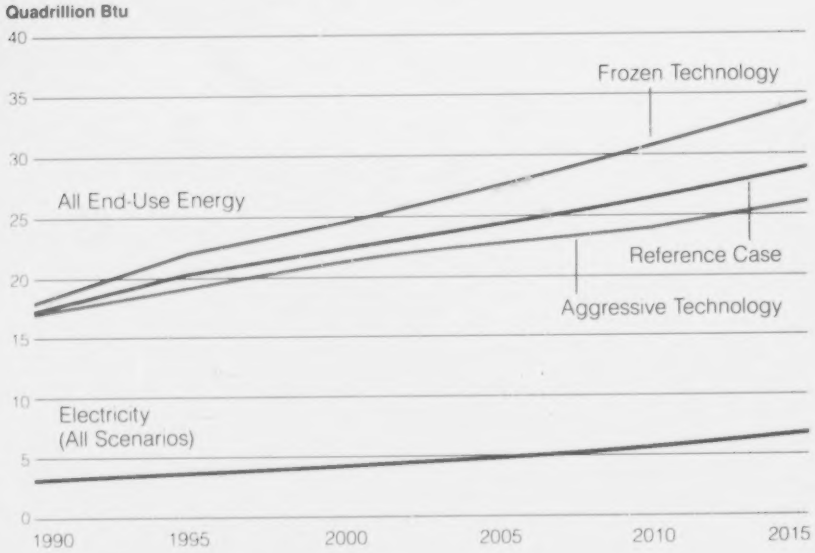
three scenarios span a wide range of innovation and change, but because of competing influences, both total electricity use (Figure 3) and average electricity use per real dollar of output (Table 4) are shown to be essentially the same throughout the forecast period. The mix of influences on the industrial demand for electricity is reflected in these numbers, but it cannot be readily isolated. Substantial electrification in process heating applications and greater reliance on electricity to operate the factories of the future are matched by significant gains in the end-use efficiencies of such existing electric applications as motors, lighting, HVAC, electrolytic devices, and the like. These competing effects, together with the expected shift in the composition of U.S. output toward the less energy-intensive industries, add up to an industrial world increasingly reliant on electricity because of its controllability in an age of automation. But, since the shift to electrification is typically accompanied by the installation of very efficient machinery and devices, the total demand for power is likely to experience only modest growth. This outlook is shared by other energy market analysts as well.[9]

Concluding Observations

Table 5 integrates the alternative energy demand cases discussed for each of the sectors, providing two composite scenarios that diverge from the Electricity Futures Project's Reference Case projection. In the absence of further improvements in end-use efficiencies beyond those already achieved—as represented by the "frozen" technology scenario—end-use energy demand would grow by around 1.6 percent in the 1990s and just a bit more slowly during the post-2000 period. Electricity use, on the other hand, would grow by about 2.4 percent in the 1990s and by 1.6 percent after 2000. But, if we assume an aggressive penetration of advanced technology, total end-use energy requirements will grow by a mere 0.8 percent per annum in the 1990s and beyond, while electricity requirements will grow by 2.0 percent in the 1990s and by half that rate in the post-2000 period. Thus, the aggressive technology scenario suggests that a major push for

Figure 3

Industrial Sector—End-Use Energy



SOURCE: Electricity Futures Project projections, 1989

advanced technology—with considerably greater electrification of the economy as a key element—would have less of a downward effect on electricity requirements than it would have on total end-use energy requirements.

What can we say about the likely momentum of a sustained drive toward greater energy end-use efficiencies? Can we expect it to last through the 1990s and serve as a focus for policy and investment?

As we begin the last decade of the century, the need for energy efficiency still lacks a broad public consensus. Nevertheless, developments are emerging that, over the long term, are likely to become even more powerful spurs for efficiency improvements than the perceived necessity to reduce America's dependence on unreliable foreign oil sources was in the 1970s:

- Rising scientific and political concern over atmospheric pollution caused in the main by the combustion of fossil fuels and wood in large concentrations. California's decision to tighten already stringent auto emission standards over a time span of 5–10 years is a clear indication of the direction public policy will be taking as Clean Air Act revisions are debated and eventually enacted in Washington.
- Recognition by the private sector that it must follow Japan's lead in making decisions based on long-term profitability rather than on short-term returns to investors. In the context of energy applications, such decision-making would point to a greater acceptance of the concept of lifecycle costing over the first-cost considerations in evaluating equipment/appliance purchases.
- The emergence of new electrification opportunities based on demonstrations of cost-effective technologies and the recognized ability (through electricity) to control pollution. This trend is discernible in proposed rail electrification; in the introduction of electric cars for special uses; in the adoption of electric arc furnaces in process-heating installations; and in refuse collection and incineration in utility boilers.
- Recognition that utility subsi-

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Table 4

Industrial Sector—Characteristics of Alternative Scenarios

	1988	2000	2015
Value of Output			
Billions of 1982 dollars	3088.9	4419.9	6264.2
Average End-Use Energy Requirements			
Thousand Btu per 1982 $ of output, annually			
Frozen technology	5.76	5.62	5.49
Reference case	5.76	5.14	4.61
Aggressive technology adoption	5.76	4.90	4.14
Average Electricity Use			
Thousand Btu per 1982 $ of output, annually			
Frozen technology	1.07	1.06	1.04
Reference case	1.07	1.07	1.07
Aggressive technology adoption	1.07	1.07	1.06
Electricity's Share of End-Use Energy			
Frozen technology	18.7%	18.8%	19.0%
Reference case	18.7%	20.8%	23.1%
Aggressive new technology adoption	18.7%	21.8%	25.5%

Table 5

Energy Demand—Composite Scenarios

	Alternative Cases		
	Frozen Tech	Ref Case	Agressive Tech
Total End-Use Energy			
Quadrillion Btu, 1988	56.3	56.3	56.3
Quadrillion Btu, 2000	68.5	64.7	62.1
Quadrillion Btu, 2015	85.1	76.0	69.5
Avg. annual growth, 1988–2000	1.6%	1.2%	0.8%
Avg. annual growth, 2000–2015	1.5%	1.1%	0.8%
Electricity			
Quadrillion Btu, 1988	9.2	9.2	9.2
Quadrillion Btu, 2000	12.2	12.3	11.7
Quadrillion Btu, 2015	15.5	15.3	13.4
Avg. annual growth, 1988–2000	2.4%	2.6%	2.0%
Avg. annual growth, 2000–2015	1.6%	1.5%	1.0%

Note: Each of the composite cases described in this table adopts the References Case projection for energy and electricty requirements in transportation

dies for energy efficient measures installed on customer premises are an effective means to accelerate energy savings and overcome barriers to market acceptance.

- Finally, as the world's largest per-capita energy consumer, the recognition that the United States has a special responsibility to strive for greater efficiency of energy use. Moreover, an opportunity exists to export our technological advances in this arena to markets in countries where the response to global environmental problems is just beginning to enter public discourse.

Our own view is that, under the weight of these pressures, public policy promoting the wiser and more efficient use of energy will remain sufficiently embedded in the national consciousness to maintain its momentum well into the new millennium.

Notes

1. A. H. Rosenfeld and D. Hafemeister, "Energy Efficient Buildings," *Scientific American*, April 1988, pp. 78–85.

2. E. Hirst et al., *Energy Efficiency in Buildings: Process and Promise*, American Council for an Energy-Efficient Economy, Washington, DC, 1986.

3. See, for example, U.S. Office of Technology Assessment, *Technology and the American Economic Transition*, Congress of the United States, Washington, DC, May 1988.

4. W. M. Burnett and S. D. Ban, "Changing Prospects for Natural Gas in the United States," *Science*, April 21, 1989, pp. 305–10; W. Fulkerson et al., "Energy Technology R&D: What Could Make a Difference?" (ORNL 6541/VI) Oak Ridge National Laboratory, Oak Ridge, TN, May 1989.

5. See note 2.

6. See note 1.

7. J. Meredith, "The Strategic Advantages of the Factory of the Future," *California Management Review*, Spring 1987, pp. 27–41.

8. M. Ross, "Improving the Efficiency of Electricity Use in Manufacturing," *Science*, April 21, 1989, pp. 311–17.

9. See, for example, note 8 and A. Kahane and R. Squitieri, "Electricity Use in Manufacturing," *Annual Review of Energy*, Vol. 12, 1987, pp. 223–51.

fluorescent and HID lamps at high frequency. The result: essentially no flicker or noise and lower ballast power losses. With fluorescents, increased efficiency is an added advantage. For example, a standard T-12 system with an electronic ballast is up to 25 percent more efficient than a T-12 system with a standard, magnetic ballast. With HID lamps, electronic ballasts allow more control over light output during the lamp's life. Some electronic ballasts offer continuous, or step, dimming capability, allowing light to be adjusted to the requirements of a particular space. With electronic ballasts, single lamps can be dimmed as easily as large groups, making possible more options for lighting control strategies such as daylighting.

Optical Reflectors

Made of aluminum, silver, or multiple dielectric coatings, optical reflectors improve the efficiency of fluorescent fixtures by up to 20 percent. The reflectors direct more light downward so that it does not bounce around inside the fixture. Such reflectors can cut lighting energy costs for existing overlighted spaces by half because they make it practical to remove half the lamps and ballasts from a fixture; the decrease in light output from that fixture is only 25-30 percent. The aluminum reflectors offer the lowest initial cost; the silver and dielectric film types have the highest reflectivity. The multiple dielectric coating can also be used on HID fixtures and has been shown to increase the efficiency of such fixtures by up to 30 percent.

Occupancy Sensors and Photocell Controls

These are just two examples of the types of technology being used to control lighting in commercial buildings. Occupancy sensors use infrared or ultrasonic signals to detect motion in a room, automatically turning lights on when motion is detected or off when none is detected. Photocell systems detect the amount of daylight entering a given space and automatically adjust the electric lighting system to maintain the desired illumination. Computer-controlled lighting management systems that incorporate several control strategies are also being used in the commercial sector. Such systems have included functions that turn lights on and off at programmed times, automatically reduce lighting loads during times of unusually high peak utility demand, and increase power to a lighting system as it dims with age and dirt accumulation.

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FINANCIAL REVIEW

THIRD QUARTER EARNINGS PER SHARE DROP

Investor-owned electric utility earnings per share (EPS), after extraordinary items, decreased 18.9 percent from $0.95 in the third quarter of 1988, to $0.77 in the third quarter of 1989. The EPS decrease was due almost entirely to writeoffs associated with plant cancellations and regulatory disallowances, writeoffs or losses related to non-utility subsidiaries, and a decrease in the accrual of allowance for funds used during construction (AFUDC).

The plant and non-utility writeoffs and losses combined to decrease net income by $1,121 million aftertax in the third quarter of 1989, versus a decrease of $339 million aftertax in the third quarter of 1988. Exclusion of these income decreasing items from EPS for the third quarter of 1989 reduces the decline in EPS by approximately 17 percentage points to only a 2 percent decline. AFUDC declined 27.3 percent, a $199 million decline from the third quarter of 1988 (see Table 1).

Even with the mild summer weather in comparison to last year's, third quarter electric operations did well. Total electric operating revenue increased by 1.5 percent from $39.3 billion in the third quarter of 1988, to $39.9 billion in the third quarter of 1989. In spite of the comparatively mild weather, a 0.2 percent increase in quarterly electricity sales was recorded over the third quarter of 1988. A major

Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Millions of Dollars)

	Three Months Ending September 30,			Twelve Months Ending September 30,		
	1989	1988r	%Change[3]	1989	1988r	%Change[3]
Total Electric Operating Revenues[1]	$39,871	$39,295	1.5	$139,161	$134,047	3.8
Electric Operating Expenses						
Fuel	$8,921	$8,910	0.1	$31,846	$31,105	2.4
Other Operation & Maintenance	10,952	10,790	1.5	44,727	42,268	5.8
Depreciation & Amortization	3,778	3,531	7.0	14,865	13,995	6.2
Costs Deferred Under Rate Phase-in Plans	(151)	(216)	(29.9)	(801)	(1,112)	(28.0)
Taxes Other Than Income Taxes	2,894	2,839	1.9	10,778	10,470	2.9
Income Taxes: Federal & Other	3,217	2,932	9.7	6,822	6,119	11.5
Deferred Income Taxes	532	765	(30.5)	2,055	2,632	(21.9)
Investment Tax Credits, Net	(62)	2	N.M.	(371)	(14)	N.M.
Total Electric Operating Expenses	$30,081	$29,553	1.8	$109,921	$105,463	4.2
Electric Operating Income	$9,790	$9,742	0.5	$29,240	$28,585	2.3
Other Utility Operating Income	(4)	(14)	(71.5)	1,260	1,169	7.8
Total Utility Operating Income	$9,786	$9,728	0.6	$30,500	$29,753	2.5
Other Income and Deductions--Net	(568)	193	N.M.	(1,738)	502	N.M.
Phase-in Deferrals	230	256	(10.0)	991	1,102	(10.1)
Allowance for Other Funds Used During Construction	240	377	(36.4)	1,191	1,684	(29.3)
Total Income Before Interest Charges	$9,688	$10,554	(8.2)	$30,944	$33,042	(6.3)
Interest Charges						
Interest on Long-Term Debt	$3,820	$3,727	2.5	15,139	14,778	2.4
Other Interest Expenses & Charges	315	277	13.9	1,253	877	42.9
Allowance for Borrowed Funds Used During Construction	(290)	(352)	(17.5)	(1,222)	(1,476)	(17.2)
Net Interest Expenses & Charges	$3,846	$3,652	5.3	$15,170	$14,178	7.0
Net Income Before Extraordinary Items	$5,843	$6,901	(15.3)	$15,774	$18,864	(16.4)
Extraordinary Items	(37)	(66)	N.M.	(28)	(66)	N.M.
Cumulative Effect of a Change in Accounting Principle	(122)	0	N.M.	(157)	(1,737)	N.M.
Net Income	$5,684	$6,835	(16.8)	$15,589	$17,061	(8.6)
Preferred Dividends Declared	523	538	(2.7)	2,124	2,210	(3.9)
Net Income Available for Common	$5,161	$6,298	(18.1)	$13,465	$14,851	(9.3)
Common Dividends Declared	3,269	3,235	1.0	12,681	12,532	1.2
Additions to Retained Earnings	$1,892	$3,062	38.2	$784	$2,319	(66.2)
Average Shares Outstanding (Millions)[2]	6,717	6,657	0.9	6,699	6,640	0.9
Earnings Per Share Before Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.79	$0.96	(17.7)	$2.04	$2.51	(18.7)
Earnings Per Share After Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.77	$0.95	(18.9)	$2.01	$2.24	(10.3)
Common Dividends Per Share[2]	$0.49	$0.49	0.0	$1.89	$1.89	0.0

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service.

[1]Revenues are adjusted for intra-industry sales for resale of electricity.
[2]Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
[3]Percent changes may reflect roundings.
r--Revised to reflect company restatements.
NM--Not Meaningful.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Millions of Dollars)

Assets 1989	September 30, 1989	September 30, 1988r	% Change[3]
Utility Plant[1]			
Utility Plant (Including Nuclear Fuel)	$481,892	$462,063	4.3
Less Accumulated Depreciation	141,670	128,400	10.3
Total	$340,222	$333,663	2.0
Construction Work in Progress	35,314	39,142	(9.8)
Net Utility Plant	$375,536	$372,805	0.7
Investments	33,444	27,615	21.1
Current Assets	42,831	42,948	(0.3)
Deferred Debits	32,879	31,962	2.9
Total Assets	$484,690	$475,329	2.0
Capitalization and Liabilities			
Capitalization			
Common Stock	$ 94,200	$ 94,127	0.1
Retained Earnings	53,885	53,720	0.3
Preferred Stock	26,071	27,386	(4.8)
Long-Term Debt	170,875	167,562	2.0
Total Capitalization	$345,031	$342,796	0.7
Current Liabilities			
Short-Term Debt	$ 10,519	$ 8,544	23.1
Long-Term Debt Due Currently	5,086	5,678	(10.4)
Other Current Liabilities	31,913	31,642	0.9
Total Current Liabilities	$ 47,518	$ 45,864	3.6
Deferred Credits			
Capital Lease Obligations, Non-Current Portion	$ 5,325	$ 4,676	13.9
Accumulated Deferred Income Taxes[2]	48,600	46,047	5.5
Accumulated Deferred Investment Tax Credits	16,310	17,137	(4.8)
Other Deferred Credits	21,905	18,810	16.5
Total Deferred Credits	$ 92,140	$ 86,669	6.3
Total Capitalization and Liabilities	$484,690	$475,329	2.0

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service

[1]Includes non-electric utility plant
[2]Includes property-related deferred income taxes
[3]Percent changes may reflect roundings

reason for the increase was the continuing strength of the economy.

The 1.5 percent increase in electric revenue was offset by a 1.8 percent increase in electric operating expenses, from $29.6 billion recorded in the third quarter of 1988 to $30.1 billion in the third quarter of 1989. As a result, the third quarter 1989 operating ratio of 75.4 percent showed little change over the third quarter 1988 ratio of 75.2 percent. Electric operating income increased form $9.7 billion in 1988 to $9.8 billion in the 1989 third quarter, a 0.5 percent increase.

Along with the small 0.2 percent increase in sales, most electric operating expenses increased only modestly. The 1.5 percent quarterly other O & M increase is significantly lower than the year-to-year increase of 5.8 percent. Fuel expense increased slightly by 0.1 percent over last year's third quarter. Fuel as a percentage of operating revenue was only 22.4 for the third quarter of 1989. This is the fifth consecutive quarter that the ratio has been under 23.0 percent. Larger increases in expenses were experienced in depreciation and amortization, which increased by 7.0 percent, and income taxes, which increased by 9.7 percent.

Costs deferred under phase-in plans decreased 29.9 percent from $216 million in the third quarter of 1988 to $151 million for the third quarter of 1989. This is the lowest amount recorded for costs deferred under phase-in plans since EEI began tracking the quarterly amount in the first quarter of 1986.

Offsetting the increase in electric operating income was a net decrease of $761 million in other income and deductions. The significant decrease was due to writeoffs reflecting losses sustained by non-utility subsidiaries and the writeoff of disallowed plant costs which totaled $962 million. Three companies recorded writeoffs of $26 million related to non-utility assets and also registered losses of $257 million relating to 1989 third quarter non-utility results. Another company recorded a $679 million dollar writeoff in the third quarter of 1989 which related to a settlement between the company and its various regulatory agencies.

The continuing decline in AFUDC in response to lower levels of new generating plant construction and the diminishing growth of phase-in plans bodes well for the quality of earnings and cash flow. AFUDC dropped 27.3 percent from $729 million in the third quarter of 1988 to $530 million in the third quarter of 1989. AFUDC as a percentage of net income available for common declined from 11.6 percent for the third quarter of 1988 to 10.3 percent for the third quarter of 1989 and, on an annual basis, was 17.9 percent of earnings for the year ending September 30, 1989.

Phase-in plan accruals (cost deferrals and phase-in revenues) as a percentage of net income available for common decreased from 7.5 percent in the third quarter of 1988 to 7.4 percent during the third quarter of 1989. The net effect of phase-in plan accruals for the third quarter was a non-cash increase to net income of $381 million, 19.3 percent less than the $472 million increase to net income experienced a year ago.

Net reductions to income of $159 million were recorded as extraordinary items or the cumulative effect of a change in accounting principle during the third quarter of 1989. An extraordinary loss of $37 million was recorded for the third quarter of 1989 versus an extraordinary loss of $66 million in the third quarter of 1988. The 1989 third quarter loss relates to a company that wrote off a deferred revenue requirement of wholesale customers. The writeoff was the result of the adoption of the Financial Accounting Standards Board's Statement 101 (Discontinuance of Statement 71) by the company. A writeoff totaling $122 million was recorded by another company to reflect the reduction in recoverable cost related to a nuclear unit not yet commercially licensed.

The coverage ratio decreased during the quarter as net interest expenses and charges rose by 5.3 percent while net income before interest charges decreased by 8.2 percent. The pretax interest coverage ratio (before extraordinary items) for the third quarter, excluding AFUDC, of 3.18 times, represented a 8.4 percent decrease from the 3.47 times of a year ago. The interest coverage ratios including AFUDC, for the same periods, were 3.65 and 3.30 respectively.

A declining Return on Equity (ROE) trend continued for the year ending September 30, 1989, as earned ROE declined to 9.2 percent. The change in ROE reflects

lowered earnings, the increase in average common equity, and downward trend in allowed returns authorized by commissions.

The dividend payout ratio (after extraordinary items) of 94.2 percent for the twelve-month period ending September 30, 1989, was up from the 84.4 percent recorded for the same period one year earlier. This increase is attributable to the year's decline in earnings and dividend increases by companies that had previously omitted or reduced their dividends as they begin recovering from the effects of large construction programs as well as the normal increase in dividends paid out.

The industry's balance sheet continues to strengthen as construction work in progress (CWIP) decreased 9.8 percent from $39.1 billion as of September 30, 1988, to $35.3 billion as of September 30, 1989. CWIP, as a percentage of net plant in service, dropped from 11.7 percent to 10.4 percent during the same period. Total utility plant increased 4.3 percent to $481.9 billion (see Table 2).

Investments for the industry increased 21.1 percent to $33.4 billion, up from the $27.6 billion recorded September 30, 1988. The increase represents, in many cases, the improved recording of subsidiary operations of holding companies by the EEI survey. The increase was also due to increased investment activity.

The common equity capitalization ratio decreased from 43.1 percent, recorded September 30, 1988, to 42.9 percent on September 30, 1989. The proportion of preferred stock in the industry capitalization ratio declined from 8.0 percent to 7.6 percent. While common equity and preferred stock declined as a proportion of total capitalization, the amount of debt as a percentage of total capitalization increased by 0.6 percentage points to 49.5 percent.

Short-term borrowing increased 23.1 percent from $8.5 billion as of September 30, 1988, to $10.5 billion as of September 30, 1989. The increase appears less significant when compared to the June 30, 1989, short-term debt amount of $11.6 billion.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample represents approximately 95.2 percent of the investor-owned electric utility industry's total assets and 96.8 percent of its electric utility revenues. The sample data are adjusted to represent the entire investor-owned electric utility industry by using the Standard & Poor's Utility Compustat II database. The 1988 data have been revised to reflect company restatements.

Contributed by Edison Electric Institute's Finance and Accounting Department.

STATISTICAL REVIEW

THIRD QUARTER SALES AND REVENUES SHOW MODEST GAINS

Third quarter 1989 sales of 546.8 megawatthours (MWh) to ultimate customers by investor-owned electric utilities represented an increase of only 0.2 percent from the 545.7 MWh sold in the third quarter of 1988 despite a relatively strong economy and a 1.5 percent increase in the number of total customers.

Comparatively cool summer weather, relative to 1988 and 1987, was a major factor behind a 2.8 percent decline in third quarter residential customer sales. On a cooling degree day basis, the third quarter of 1989 was 12.4 percent cooler than 1988 and 4.4 percent cooler than 1987. The decline in residential sales essentially offset the third quarter sales gains of 3.2 percent for commercial customers and 1.2 percent for industrial customers (see Table 1).

Third quarter 1989 total revenues of $38.2 billion represented an increase of 1.3 percent from the $37.7 billion reported in the third quarter of 1988. Again, a decline in revenues from the weather sensitive residential customer class partially offset gains in the commercial and industrial customer classes. The low level of rate increases (including fuel adjustment clauses) also affected the revenue gain.

The strength of the economic growth in the third quarter is evidenced by an increase in the GNP of 3.0 percent, higher than the preliminary estimate of 2.5 percent and the second quarter increase of 2.5 percent.

Total sales for the twelve-month period ending September 30, 1989, increased 2.5 percent from the 1948.0 MWh sold in the same period ending September 30, 1988. Over the same period, total

Table 1
Third Quarter Customer, Sales and Revenue Data for Investor-Owned Electric Utilities

	Three Months Ended September 30,			Twelve Months Ended September 30,		
	1989	1988	% Change	1989	1988	%Change
Number of Customers						
Residential	72,468,144	71,459,406	1.4	72,175,229	71,104,605	1.5
Commercial	9,098,362	8,929,524	1.9	9,019,494	8,836,279	2.1
Industrial	386,780	377,294	2.5	375,003	366,535	2.3
Street and Highway	132,920	130,689	1.7	131,972	129,279	2.1
Other Public Authorities	155,096	151,198	2.6	154,113	149,771	2.9
Railroads	22	22	0.0	22	22	0.0
Interdepartmental	462	462	0.0	464	444	4.5
Total Customers	82,241,786	81,048,595	1.5	81,856,297	80,586,935	1.6
Electricity Sales (MWh)						
Residential	182,690,399	187,967,102	(2.8)	648,919,573	641,100,544	1.2
Commercial	169,049,975	163,805,337	3.2	589,286,707	568,724,601	3.6
Industrial	180,698,670	178,472,241	1.2	699,837,772	679,808,372	2.9
Street and Highway	2,463,766	2,473,662	(0.4)	10,379,895	10,399,638	(0.2)
Other Public Authorities	10,737,070	11,860,525	(9.5)	44,496,052	43,880,652	1.4
Railroads	621,675	623,804	(9.6)	2,418,310	2,362,717	2.4
Interdepartmental	564,050	502,160	12.3	2,127,607	1,731,696	22.9
Total Sales	546,825,605	545,704,831	0.2	1,997,465,916	1,948,008,220	2.5
Revenues($000)						
Residential	15,370,335	15,539,241	(1.1)	51,316,332	49,761,994	3.1
Commercial	12,508,131	12,079,747	3.5	42,544,053	40,852,053	4.1
Industrial	9,346,285	9,125,880	2.4	33,666,870	32,691,632	3.0
Street and Highway	302,116	293,570	2.9	1,197,052	1,183,023	1.2
Other Public Authorities	630,754	639,798	(1.4)	2,392,638	2,337,438	2.4
Railroads	42,315	41,924	0.9	153,029	148,723	2.9
Interdepartmental	33,172	29,714	11.6	124,633	106,951	16.5
Total Revenues	38,233,108	37,749,874	1.3	131,394,607	127,081,814	3.4

SOURCE: Edison Electric Institute, Statistics Department

revenues increased 3.4 percent from $127.1 billion to $131.4 billion. The 2.5 percent increase in total sales is the lowest twelve-month increase since that reported for the year ending June 30, 1987.

For the last year, the rate of increase of total customers has appeared to be declining. For the past seven years, the percentage increase in customers for the twelve months ending September 30 has averaged 1.8 percent annually. For the twelve months ending September 30, 1989, this increase was only 1.6 percent, and the quarterly increase was only 1.5 percent.

The residential customer class makes up approximately seven eighths of total customers on an unweighted basis. Thus, it is this customer class that exerts a dominating influence on the total number of customers. Historically, the percentage increase in the number of residential customers has been 0.1 percentage points below the increase in total customers.

While no definitive explanation is offered for this trend, if indeed it is a trend, one could speculate that it is a consequence of the decline in population growth which occurred during the 1960s, when the growth rate in population fell from 1.7 percent annually in 1959 to 1.0 percent by 1969.

Contributed by Edison Electric Institute's Finance and Accounting Department.

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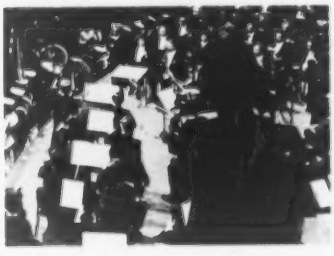

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FINANCIAL REVIEW

DESPITE STRONG FOURTH QUARTER, 1989 EARNINGS PER SHARE DECLINE

Investor-owned electric utility earnings per share (EPS), before extraordinary items and the cumulative effects of accounting principle changes, decreased 1.8 percent from $2.20 in 1988, to $2.16 in 1989, despite a 3.1 percent utility operating income increase.

Writeoffs resulting from regulatory disallowances and diversification, along with a lower accruals of allowance for funds used during construction (AFUDC) and phase-in plans, caused the earnings decrease. If 1989 writeoffs are excluded, $0.39 a share would have been added to the $2.12 final 1989 EPS after extraordinary items and the cumulative effect of a change in an accounting principle figure. Total AFUDC contributed almost $600 million less to earnings in 1989 versus 1988, while phase-in plan accruals declined by almost $400 million.

EPS before extraordinary items and the cumulative effect of changes in accounting principles for the fourth quarter of 1989 were $0.34, up from the fourth quarter 1988 $0.12 per share, a 183.3 percent increase. Electric operating income for the fourth quarter of 1989 was up 5.1 percent over 1988 based on a 4.4 percent sales increase. However, most of big swing in the quarterly increase was primarily due to a significant amount of writeoffs in the fourth quarter of 1988. Fourth quarter 1989 writeoffs were only $1.0 billion after-tax in comparison to the 1988 amount of $1.7 billion.

Income Statement

Total electric operating revenue increased from $135.7 billion in 1988 to $141.2 billion in 1989, a 4.0 percent increase. The increase reflected strong 1989 electricity sales growth of 2.5 percent and, to a certain extent, rate increases.

The yearly operating electric revenue increase was offset by a 4.3 percent increase in electric operating expense from $107.1 billion recorded in 1988 to $111.7 billion in 1989. This caused the operating ratio to increase slightly from 78.9 percent in 1988 to 79.1 percent for 1989. The operating expense increase was primarily due to the increase of other operation and maintenance, fuel and depreciation expenses. Other operation and maintenance and depreciation expenses accounted for $3.3 billion of the $4.6 billion difference between the total operation expense amounts for 1988 and 1989.

Fuel expense increased 2.9 percent from $31.4 billion in 1988 to $32.3 billion in 1989. Despite lower percentage increases over the preceding year for the first three quarters of 1989 for fuel expense, the fourth quarter increased 7.3 percent over the fourth quarter of 1988. Extreme cold weather throughout the eastern two thirds of the country during the fourth quarter increased demand for peaking power, which in turn caused many companies to use high cost fuels, primarily oil. Milder weather had kept the quarterly percentage growth of fuel expense low for the preceding three quarters.

Annual and quarterly results for the industry's 1988 and 1989 income statement show the impact of regulatory and accounting treatment of recently completed plants and the impact of diversification. During 1989, after-tax writeoffs totaled $2.7 billion, while in 1988, this amount totaled $4.1 billion. On the EEI consolidated income statement, these amounts are contained in three accounts, i.e., other income and deductions, extraordinary items, and the cumulative effect of a change in an accounting principle. Most writeoff amounts were related to final rate case decisions that included a plant disallowance or abandonment. Included in the annual after-tax writeoff amounts are an estimated $300 million in 1988 and $750 million in 1989 from non-utility operations.

The losses recorded in other income & deductions of $940 million for 1988 and $731 million for 1989 were caused in most part by the writeoffs. If they are excluded, there would have been a gain in 1989 of an estimated $1.7 billion in the line item.

Allowance for funds used during construction dropped 20.0 percent

Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Millions of Dollars)

	Three Months Ending December 31,			Twelve Months Ending December 31,		
	1989	1988r	%Change[3]	1989	1988r	%Change[3]
Total Electric Operating Revenue[1]	$34,196	$32,304	5.9	$141,166	$135,708	4.0
Electric Operating Expenses						
Fuel	$ 8,194	$ 7,637	7.3	$ 32,345	$ 31,434	2.9
Other Operation & Maintenance	12,151	11,896	2.1	45,158	43,621	3.5
Depreciation & Amortization	3,786	3,574	5.9	15,090	14,220	6.1
Costs Deferred Under Rate Phase-in Plans	(120)	(204)	(41.3)	(674)	(1,024)	(35.3)
Taxes Other Than Income Taxes	2,610	2,525	3.3	10,852	10,529	3.1
Income Taxes: Federal & Other	1,121	1,002	11.9	7,006	6,337	10.6
Deferred Income Taxes	429	308	39.4	2,160	2,331	(7.3)
Investment Tax Credits, Net	(83)	(246)	(66.3)	(250)	(317)	(21.3)
Total Electric Operating Expenses	$28,088	$26,491	6.0	$111,688	$107,113	4.3
Electric Operating Income	$ 6,108	$ 5,812	5.1	$ 29,479	$ 28,595	3.1
Other Utility Operating Income	321	367	(12.7)	1,225	1,280	(4.3)
Total Utility Operating Income	$ 6,429	$ 6,180	4.0	$ 30,704	$ 29,876	2.8
Other Income and Deductions--Net	(376)	(1,729)	(78.2)	(731)	(940)	(22.3)
Phase -in Deferrals	238	234	1.6	968	994	(2.6)
Allowance for Other Funds Used During Construction	358	367	(2.6)	1,166	1,534	(24.0)
Total Income Before Interest Charges	$ 6,648	$ 5,052	31.6	$ 32,107	$ 31,465	2.0
Interest Charges						
Interest on Long-Term Debt	$ 3,816	$ 3,743	1.9	15,199	14,824	2.5
Other Interest Expenses & Charges	308	294	4.8	1,255	1,055	18.9
Allowance for Borrowed Funds Used During Construction	(312)	(341)	(8.6)	(1,190)	(1,410)	(15.6)
Net Interest Expenses & Charges	$ 3,812	$ 3,696	3.1	$ 15,264	$ 14,469	5.5
Net Income Before Extraordinary Items	$ 2,836	$ 1,356	109.2	$ 16,843	$ 16,995	(0.9)
Extraordinary Items	(73)	(20)	267.8	(101)	(86)	17.4
Cumulative Effect of a Change in Accounting Principle	(2)	(1)	185.4	(159)	(1,338)	(88.1)
Net Income	$ 2,761	$ 1,335	106.8	$ 16,583	$ 15,571	6.5
Preferred Dividends Declared	518	533	(2.8)	2,106	2,172	(3.0)
Net Income Available for Common	$ 2,243	$ 802	179.6	$ 14,477	$ 13,399	8.0
Common Dividends Declared	3,178	3,124	1.7	12,675	12,627	0.4
Additions to Retained Earnings	($ 936)	($ 2,322)	59.7	$ 1,802	$ 772	133.4
Average Shares Outstanding (Millions)[2]	6,842	6,779	0.9	6,[illegible]	6,750	1.0
Earnings Per Share Before Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.34	$0.12	183.3	$2.16	$2.20	(1.8)
Earnings Per Share After Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.33	$0.12	175.0	$2.12	$1.98	7.1
Common Dividends Per Share[2]	$0.46	$0.46	0.0	$1.86	$1.87	(0.5)

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service

[1]Revenues are adjusted for intra-industry sales for resale of electricity.
[2]Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
[3]Percent changes may reflect roundings.
r--Revised to reflect company restatements.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Millions of Dollars)

Assets	December 31, 1989	December 31, 1988r	% Change[2]
Utility Plant[1]			
Utility Plant (Including Nuclear Fuel)	$484,071	$461,414	4.9
Less Accumuated Depreciation	142,844	130,477	9.5
Total	$341,227	$330,937	3.1
Construction Work in Progress	36,221	39,551	(8.4)
Net Utility Plant	$377,448	$370,488	1.9
Investments	26,064	21,185	23.0
Current Assets	44,310	42,748	3.7
Deferred Debits	33,932	33,031	2.7
Total Assets	$481,753	$467,452	3.1
Capitalization and Liabilities			
Capitalization			
Common Stock	$ 94,080	$ 92,854	1.3
Retained Earnings	53,209	51,389	3.5
Preferred Stock	25,948	26,834	(3.3)
Long-Term Debt	170,644	166,833	2.3
Total Capitalization	$343,881	$337,910	1.8
Current Liabilities			
Short-Term Debt	8,494	$ 7,637	11.2
Long-Term Debt Due Currently	6,044	5,901	2.4
Other Current Liabilities	34,953	32,913	6.2
Total Current Liabilities	$ 49,491	$ 46,411	6.6
Deferred Credits			
Capital Lease Obligations, Non-Current Portion	$ 5,026	$ 4,891	2.8
Accumulated Deferred Income Taxes	50,389	46,892	7.5
Accumulated Deferred Investment Tax Credits	15,951	16,549	(3.6)
Other Deferred Credits	17,014	14,760	15.3
Total Deferred Credits	88,381	83,131	6.3
Total Capitalization and Liabilities	$481,753	$467,452	3.1

SOURCE: EEI Survey Data and Standard and Poors Compustat II Database Service

[1]Includes non-electric utility plant
[2]Percent changes may reflect roundings
r--Revised to reflect company restatements

from $2,945 million in 1988 to $2,356 million in 1989. Contributing to the decline were completion of plants and lower levels of long-term construction. The drop in AFUDC resulted in the improvement of the quality of earnings for the industry, as AFUDC as a percentage of net income available for common declined from 22.0 percent in 1988 to 16.3 percent for 1989.

Despite the significant decline in AFUDC on an annual basis, the quarterly decrease was much less. During the fourth quarter of 1989 AFUDC decreased only 5.5 percent compared to the 1988 fourth quarter, primarily due to one company gaining regulatory approval to resume the accrual of AFUDC early in the fourth quarter. Despite the decline in the consolidated amount of AFUDC for the industry, during the fourth quarter almost 60 percent of the EEI sample of companies recorded an AFUDC increase over the fourth quarter of 1988.

The declining trend of the electric utility industry's earned return on average common equity (ROE) continued in 1989 as earned ROE decreased to 10.1 percent from 10.3 percent in 1988. The change in ROE reflects the increase in average common equity, the downward trend in allowed returns authorized by commissions, and lowered income levels due to writeoffs. Exclusion of 1989 writeoffs would increase earned return on common equity approximately 180 basis points, from 10.1 percent to 11.9 percent.

A "quick" cash flow calculation from the income statement indicates that the industry's 1989 cash flow increased 8.7 percent over 1988. The "quick" cash flow was calculated by combining additions to retained earnings, depreciation & amortization, deferred taxes, deferred investment tax credits, and significant non-cash, non-recurring, accounting adjustments to get an initial cash flow amount. From this amount non-cash AFUDC and phase-in accruals are subtracted. The cash flow increase came despite increasing income tax costs and lower levels of deferred taxes. Income tax costs were higher in 1989 than in 1988 by almost $900 million, increasing from $18.9 billion to $19.8 billion. Deferred taxes and investment tax credits, on the other hand, decreased $238 million 1989 versus 1988, a 7.3 percent decline, primarily due to the Tax Reform Act of 1986.

The dividend payout ratio (after extraordinary items) for 1989 of 87.6 percent, was down from the 94.2 percent recorded for the twelve months ending for 1988. This decrease was caused by the 1989 increase in earnings after extraordinary items, while total common dividends declared increased only slightly (1.7 percent). This was primarily due to five companies omitting their dividend during 1989, while only three which had omitted their dividend, resumed payments.

Balance Sheet

Total assets for the investor-owned electric utilities grew by 3.1 percent over the $467.4 billion recorded for the twelve months ending December 31, 1988. The small growth in total assets reflects the writeoffs incurred and a decline in baseload generation plant construction projects. Despite the smaller growth in total assets, a recent EEI study indicates that the investor-owned segment of the electric utility industry continues to be very capital intensive. Investor-owned electric companies had to make an investment of $3.15 to earn a dollar of annual revenue based on 1988 data. This made investor-owned electric utility companies approximately 1.7 times more capital intensive than the next most capital intensive industry, mining.

Investments for the industry increased 23.0 percent to $26.1 billion, up from the $21.2 billion recorded December 31, 1988. The increase is attributable to a increase in investment in non-utility operations.

Total capitalization for the industry increased from $337.9 billion as of December 31, 1988, to $343.9 billion as of December 31, 1989, a 1.7 percent increase. The main contributors to the increase were common equity, which increased 2.1 percent, and long-term debt, which increased 1.9 percent. The growth of total common equity was reduced by

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companies engaging in common stock buyback programs. The increase in total common equity caused the share of total capitalization to increase from 42.7 percent at year-end 1988 to 42.8 percent at year-end 1989. The amount of debt as a percentage of total capitalization increased by 0.2 percentage points to 49.6 percent.

Running counter to the increasing amounts of common equity and debt was a decrease in the amount of preferred stock. Preferred stock as a percentage of total capitalization dropped by 0.4 percentage points to 7.5 percent. The decrease was due to a number of companies redeeming high cost preference and preferred stock issues in order to lower financing costs. Short-term debt showed a 11.2 percent increase to $8.5 billion as of December 31, 1989.

The embedded cost of long-term debt for the twelve months ending December 31, 1989, was 9.0 percent, down from the 9.1 percent recorded for 1988. On an annual basis, this is the lowest this ratio has been since 1980.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample represents approximately 94.9 percent of the investor-owned electric utility industry's total assets and 96.1 percent of its electric utility revenues. The sample data are adjusted to represent the entire investor-owned electric utility industry by using the Standard & Poor's Utility Compustat II database.

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REGULATORY REVIEW

DISTRICT COURT RULES IN FAVOR OF SCE IN ANTITRUST CASE

The District Court of the Southern District of California has decided in favor of Southern California Edison in an antitrust suit filed by the City of Vernon, California. In oral and written decisions Judge Mariana Pfaelzer granted Edison's three Motions for Summary Judgments in the case and denied two such Motions by Vernon. In doing so, Pfaelzer established that under the antitrust laws a utility that controls essential facilities may legitimately give first priority to serve its customers' needs.

Vernon, California, is a municipal utility whose service area is completely surrounded by Edison. Vernon purchases some of its power requirements from Edison and the remainder from other sources using firm transmission service which the utility had agreed to provide. Edison had also agreed to provide Vernon with interruptible transmission service, which the utility interrupts when the transmission facilities are used to serve its retail and wholesale customers, including Vernon.

Vernon complained that Edison had deprived it of adequate access to Edison's transmission facilities in violation of the antitrust laws, specifically Sections 1 and 2 of the Sherman Act, particularly because Edison had interrupted transmission service. Vernon claimed that the antitrust laws

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STATISTICAL REVIEW

1989 SALES UP 2.5 PERCENT

Electricity sales to ultimate customers by investor-owned electric utilities rose from 1,969 million MWh in 1988 to 2,018 million MWh in 1989. The 2.5 percent increase was accompanied by a 1.5 percent in total customers.

The growth in annual sales was primarily due to the good economic conditions experienced by the nation in 1989. However, the increase was significantly lower than the 4.7 percent increase seen for sales in 1988. The slower growth pace was due in part to the fact that GNP grew at a faster rate in 1988 than it did in 1989. Also, milder weather conditions, in particular, a much cooler summer in 1989 than in 1988 played a significant role. (See Table 1.)

Sales to commercial and industrial customers classes, responding to the continuing relatively healthy economy during 1989, were up by 3.5 and 2.7 percent respectively over 1988. During 1989, the economy, as measured by GNP in constant 1982 dollars, grew at an annual rate of 3.0 percent according to the Bureau of Economic Analysis. The number of customers increased 2.0 percent in the commercial class and 2.5 percent in the industrial class.

For residential customers, the effects of the comparatively mild summer and extremely cold December tended to cancel each other out in 1989, resulting in an annual increase in residential sales of only 1.3 percent over 1988. This growth is approximately consistent with the increase in the number of residential customers, 1.5 percent.

Total revenues for the twelve-month period ending December 31, 1989 increased by 3.8 percent from $128.4 billion to $133.2 billion. This increase is slightly lower than the 4.0 percent increase reported for the twelve-month period ending December 31, 1988 and is due to the reduced rate of growth in residential revenues (3.2 percent in 1989 versus 5.2 percent in 1988).

Total electricity sales made to ultimate customers by investor-

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A Commitment to Success

Table 1
1989 Customer, Sales and Revenue Data for Investor-Owned Electric Utilities

	Three Months Ended December 31,			Twelve Months Ended December 31,		
	1989	1988	% Change	1989	1988	%Change
Number of Customers						
Residential	72,998,734	71,858,894	1.6	72,460,189	71,410,873	1.5
Commercial	9,167,224	8,973,415	2.2	9,067,947	8,890,449	2.0
Industrial	378,652	369,373	2.5	377,323	368,279	2.5
Street and Highway	138,126	131,442	5.1	133,643	130,099	2.7
Other Public Authorities	154,491	151,828	1.8	154,778	150,565	2.8
Railroads	22	22	0.0	22	22	0.0
Interdepartmental	463	467	(0.9)	463	454	2.0
Total Customers	82,837,712	81,485,441	1.7	82,194,365	80,950,741	1.5
Electricity Sales (MWh)						
Residential	158,316,383	150,016,388	5.5	657,219,568	648,557,146	1.3
Commercial	144,599,719	138,117,934	4.7	595,768,492	575,621,435	3.5
Industrial	176,732,472	172,315,482	2.6	704,254,762	685,844,527	2.7
Street and Highway	2,847,677	2,773,604	2.7	10,453,968	10,397,363	0.5
Other Public Authorities	12,839,803	11,028,401	16.4	46,307,454	44,414,235	4.3
Railroads	650,804	598,941	8.7	2,470,173	2,398,946	3.0
Interdepartmental	387,538	610,860	(36.6)	1,904,485	1,886,542	1.0
Total Sales	496,374,396	475,461,610	4.4	2,018,378,902	1,969,120,194	2.5
Revenues($000)						
Residential	12,331,184	11,580,526	6.5	52,066,990	50,473,795	3.2
Commercial	10,530,880	9,873,318	6.7	43,201,616	41,236,932	4.8
Industrial	8,418,097	8,065,655	4.4	34,019,312	32,849,549	3.6
Street and Highway	307,829	295,876	4.0	1,209,005	1,181,298	2.3
Other Public Authorities	626,666	568,891	10.2	2,450,413	2,344,289	4.5
Railroads	41,474	37,206	12.3	157,597	150,151	5.0
Interdepartmental	15,486	33,271	(53.5)	106,849	116,350	(8.2)
Total Revenues	32,271,916	30,454,743	6.0	133,211,782	128,352,364	3.8

SOURCE: Edison Electric Institute, Statistics Department

owned electric utilities were strong in the fourth quarter of 1989, increasing by 4.4 percent from 475.5 million MWh in the fourth quarter of 1988 to 496.4 million MWh. Increased electricity sales to the residential customer class made up the bulk of the fourth quarter sales increase. Fourth quarter 1989 residential sales, strongly affected by the extremely cold weather experienced by the nation in December, rose 5.5 percent from 150.0 million MWh in 1988 to 158.3 million MWh in 1989. This contrasts with the 2.8 percent decline for the third quarter of 1989. Total revenues for the 4th quarter of 1989 rose by 6.0 percent from $30.5 billion in 1988 to $32.3 billion, the highest increase in total revenues for any quarter since the second quarter of 1985.

Despite a sluggish increase in GNP of only 0.9 percent during the fourth quarter of 1989, commercial and industrial sales put forth a reasonably good performance during the quarter increasing by 4.7 percent and 2.6 percent, respectively. These customer classes are not as weather sensitive as the residential class.

As noted in our report for the third quarter of 1989, the rate of growth in total customers on an annual basis has been declining each quarter since the second quarter of 1988. The current 1.5 percent increase continues that trend, which is dominated by the residential class.

Contributed by Edison Electric Institute's Finance and Accounting Department.

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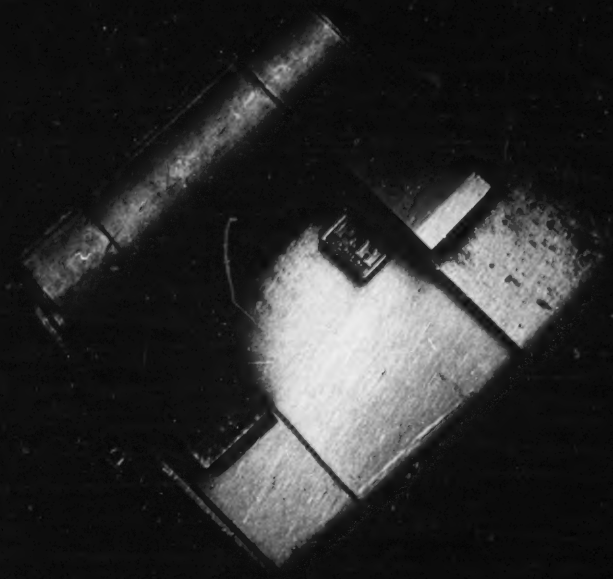
ELECTRIC PERSPECTIVES

JULY–AUGUST 1990



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The Magazine for Management in America's Investor-Owned Electric Utilities

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Utilities, the Generation Gap, and Who Do You Trust?

Wisconsin Public Service unravels a customer satisfaction mystery that leads "back to the future."

This is a detective story. It is a search for the missing customer satisfaction. It's a mission to find out why, if most customers love us so much, some others hate us so. We think part of the answer can be found in the age-old generation gap and part can be found in our past.

Most utility executives know the biggest influence on customer satisfaction is whether the utility bill is going up or not. When utility bills stabilize, all other things being equal, customer satisfaction goes up.

That was the case for Wisconsin Public Service, a medium-sized utility serving northeastern Wisconsin and parts of Upper Michigan. Public Service's rates have been stable since 1983, and customer satisfaction levels have risen to unprecedented levels, especially since the company added programs to assist the elderly and the poor and vigorously promoted conservation. In fact, customer satisfaction rose so much that by 1988, when customers were asked to rank their satisfaction on a scale of 1 to 7, with 1 being "not at all satisfied" and 7 being "very satisfied," Public Service averaged just under 6.

At this stage, it was tempting to say "We've won the customer satisfaction battle," but despite all this good customer feeling, there was a faint background noise of customer dissatisfaction which wouldn't go away.

The same problem is evident in national surveys on utilities. The data show utility customers becoming more satisfied, yet, paradoxically, they seem vaguely unhappy with investor-owned utilities as a whole. For example, according to some national surveys, customers' acceptance of private ownership of utilities has dropped over the past several years.

To unravel this mystery, in 1988 Wisconsin Public Service commissioned Matousek & Associates, an innovative marketing research firm from Green Bay, Wisconsin, to help us discover who our unsatisfied customers are and why they are unhappy with us.

After a period of brainstorming with the researchers, we decided the best approach was to examine the components of customer satisfaction. In other words, what are the attributes of our company and its interaction with customers that tend to increase or decrease satisfaction?

We started to make a list. In a short time we had over 200 attributes which affect customer satisfaction. Obviously, if we had developed a survey using this data, it would have been too long and too difficult for the customer to fill out. To get the numbers down to a manageable level, we looked for representative attributes. To do this, we discussed customer satisfaction at our regularly scheduled customer advisory panels, commissioned focus groups, and reviewed the current marketing literature and previous surveys done for Wisconsin Public Service.

The landmark customer segmentation research conducted by Cambridge Reports for Edison Electric Institute proved especially helpful. That research demonstrated that customers evaluate their utilities as both product and service providers. We tried to incorporate both dimensions in our survey.

In the end we selected 51 company attributes which together provide a reasonably accurate description of customer satisfaction. Examples include "providing accurate bills," "being honest with the public," "having attractive facilities," and "having employees I can trust." The survey asked the customer to rank the importance of each of the 51 attributes on a scale of 1-7, with 1 being "not at all important" and 7 being "very important." They then ranked how well we were performing in that area, with 1 being "poor" and 7 being "excellent." In another part of the survey, we probed additional issues to examine their relationship to customer satisfaction. Because we were particularly concerned with customers' attitudes about the ownership of utilities, we asked about that as well.

We ran the survey in January of 1989. As expected, the data showed

Michael Kiefer is Director of Corporate Communications for Wisconsin Public Service Corporation.

Siemens Power Corporation

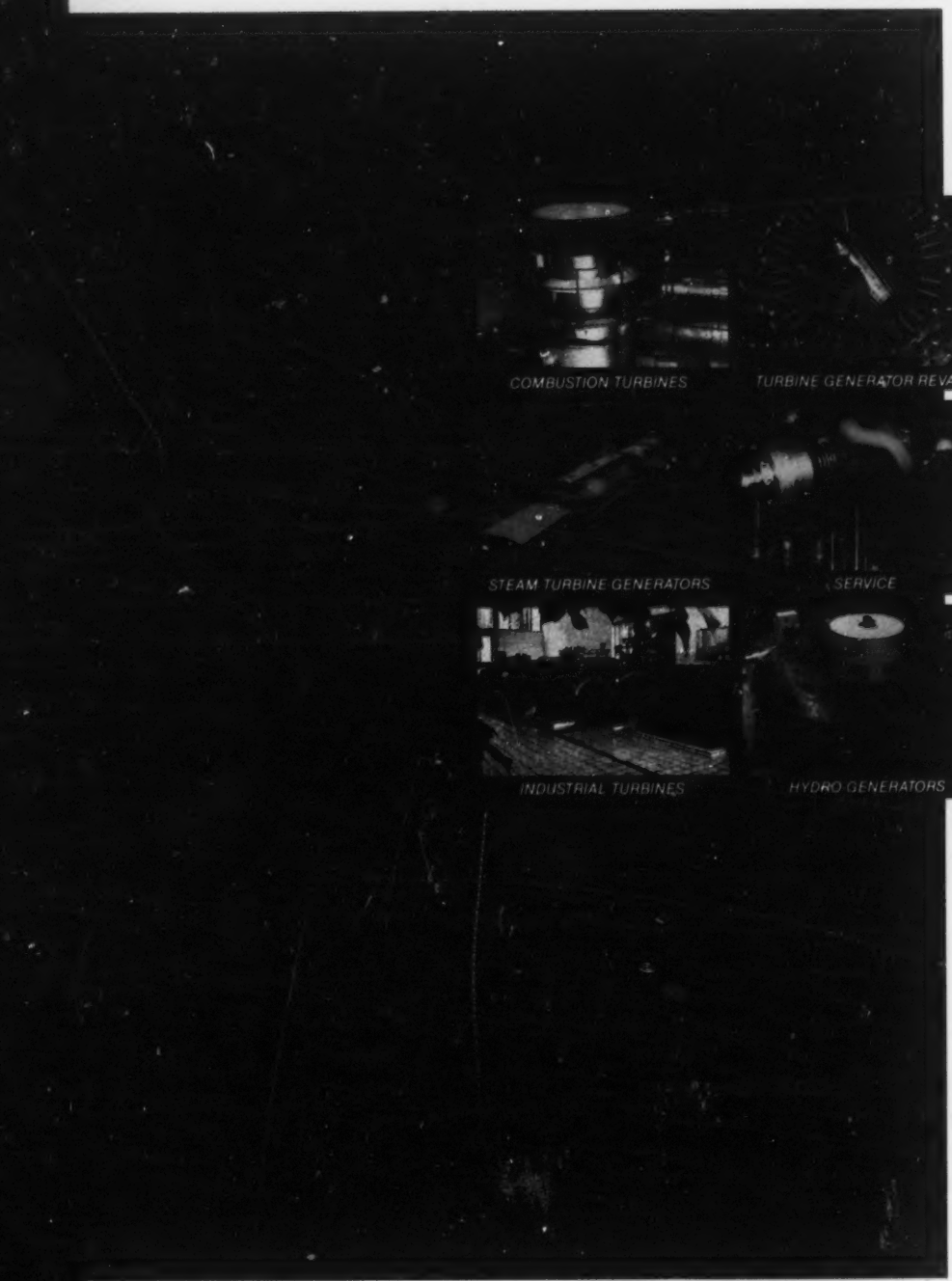

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Table 1

The Composition of theTrust and Caring Factor and the Management and Leadership Factor

Trust and Caring Factor Attributes
Showing concern about customers
Having employees I can trust
Being honest with the public
Being concerned with the environment
Being concerned with future energy needs
Providing accurate bills
Reading my meter correctly
Management and Leadership Factor Attributes
Managing WPS effectively
Actively finding ways to save energy
Actively taking a lead with problems

very high levels of customer satisfaction. Yet, when we compared our numbers on who should own the local utility with an earlier national survey, we felt mixed emotions. Forty-five percent of our customers felt that their utility should be owned by stockholders or investors, compared to 31 percent nationally. We were proud that we were beating the national average, but, nonetheless, it was a sobering experience to see that fewer than half of our customers clearly support private ownership. (Twenty-four percent prefer public or government ownership, and 31 percent have no preference.)

How could that be when the same survey demonstrated that our customers were more than moderately satisfied with our service overall? The majority had rated us at 6 or 7 for most of the 51 attributes. Clearly, more powerful analysis was required.

Digging Further

Fortunately, in the past 20 years computers have greatly eased the job of analyzing surveys, calculating in minutes statistical relationships that would take weeks or months to do by hand. Using tools such as factor analysis, cluster analysis, and regression analysis, we began to discover patterns in the data.

Factor analysis showed the 51 attributes could be clumped comfortably into nine categories or factors. Each of the attributes within a group was strongly associated with the others. We tagged the nine factors with representative names: "trust and caring," "management and leadership," "personal service," "community concern," "operational services," "personnel," "customer communication," "power outages," and "billing procedures." Seven of the attributes, for example, were most closely related to the "trust and caring" factor and three were most closely related to the "management and leadership" factor. (See Table 1.)

Through regression analysis of the nine factors, we found that the attributes associated with the "trust and caring" factor and the "management and leadership" factor were the best predictors of overall customer satisfaction. Then, through cluster analysis, it became apparent that the two factors were related positively along a continuum. This meant that if an individual rated our performance high on the factor "trust and caring," he or she tended to rate us high on the other factor, "management and leadership."

A comparison of customers who rated us high on those two factors with those who rated us low revealed some interesting trends. Those giving us the highest ratings tended to be among our oldest, least educated and lowest income customers. In contrast, those ranking us lowest tended to be customers in the 35-44 age group and to have the highest education and income levels. (See Table 2.)

Getting Warmer

Now we were getting somewhere, for a somewhat similar pattern had emerged when we looked at our "gap scores" on the ownership question. The gap score for an attribute is simply

Table 2

Demographic Analysis of Predictive Factors

	Trust and Caring	Management and Leadership
High-score Age Group	65+	65+
Low-score Age Group	35-44	35-44
High-score Education Group	Grade School	Grade School
Low-score Education Group	College or More	College or More
High-score Income Bracket	Less than $15,000	Less than $15,000
Low-score Income Bracket	$45,000 or more	$45,000 or more

Table 3

Average Gap Scores For Customers Preferring Government/Public Utility Ownership

Trust and Caring	-0.95
Management and Leadership	-0.93
Billing Problems	-0.69
Personal Service	-0.58
Customer Communication	-0.49
Power Outages	-0.48
Community Concern	-0.47
Operational Service	-0.40
Personnel	-0.34

the difference between how customers rank the attribute's importance and how they rank our performance. If the importance score is higher than the performance score, we assign a negative value to the gap between them to indicate that our performance is falling short of the attribute's importance. Conversely, if our performance score exceeds the attribute's importance, we assign the gap a positive value. For example, the average importance score given by all customers to the attributes associated with the "trust and caring" factor was 6.64, and the average performance score was 5.92; thus, the average gap score for the factor was a negative 0.72.

When we looked at the gap scores for customers who expressed a preference for government/public ownership, once again the "trust and caring" and "management and leadership" factors emerged as the most critical. (See Table 3.) It is in those two critical areas that customers who prefer government/public ownership see the largest discrepancy between the importance of the attributes and our ability to excel at them.

Finally, we began to hope that we were getting close to discovering the key to our mystery. Were these proponents of government/public ownership the same 35-44 year olds, well educated and well paid, who tended to rate us low on "trust and caring" and "management and leadership"?

Well, as with all good mysteries, the answer was not quite so simple. The data revealed no statistical differences in the educational backgrounds of those preferring investor ownership and those preferring government/public ownership. And, in fact, of the customers expressing a preference, ones with the highest incomes tended to favor investor ownership.

Regarding age, however, we discovered a match, an admittedly less than perfect match, but enough of one to make us curious. On the basis of age, those most likely to give us the lowest scores on "trust and caring" and "management and leadership" were in the 35-44 age group. This is the same group that gave us our lowest overall rating for performance. Those giving us the second-lowest score overall and on "trust and caring" were 18 to 34 years old.

It is these same two age groups who most often prefer government/public ownership over investor ownership. In fact, 56 percent of those favoring government/public ownership are 44 years old or younger. In contrast, 43 percent of those favoring investor ownership are 55 years old or older. (See Table 4.)

The Generation Gap

It was becoming clear that there was a gap, a generation gap if you will, between these younger customers and Wisconsin Public Service. The vast majority of these younger customers are members of the baby-boom generation. (Of the 322 survey respondents in the 18-44 age group, only 29 were younger than 25 years of age.)

As we continued to work the data, additional associations became clear. These baby boomers were most concerned about three issues—the environment, conservation, and the community. They were looking for WPS to take a leadership role on these issues, and, apparently, we were not meeting their expectations.

To make sure we were analyzing the data correctly, we held three focus groups comprised of "baby boomers"

Table 4

Ownership Preference By Age

	Investor	Government and/or Public
18-34	19%	34%
35-44	20%	22%
45-54	18%	16%
55-64	16%	14%
65 +	27%	14%
Total	100%	100%

to probe the areas of the environment, conservation, and community relations. Additionally, we wanted to explore in depth one particularly puzzling gap score from the survey. Of all 51 attributes, "being honest with the public" had the highest gap between what customers thought was important and how they ranked our performance. This gap was especially troubling because WPS has made special efforts to be honest and open with the public.

Wisconsin Public Service

To help reduce the need to trim trees that their customers cherish, during Arbor Week WPS advised residents to plant trees on the south side of their homes to reduce the need for air conditioning but not to plant them under power lines. WPS also arranged for low-growing species to be planted near some of their lines.

As it turned out, the honesty attribute was the key to solving our mystery.

The focus groups were held in the fall of 1989. Both rural and urban areas were represented. It is important to note all the customers in the focus groups ranked the utility favorably on customer satisfaction; none gave us lower than 4 on the 1-7 scale. Still, they did have concerns.

The first issue we probed was the *environment.* WPS has had many innovative programs on the environment ranging from the donation of substantial tracts of land to environmental groups and local communities to the development of nesting sites for cormorants (an endangered species in the Green Bay area) and assisting the State of Wisconsin in enhancing fish populations.

Even though favorable publicity was generated on these programs, the focus groups indicated there was almost a total lack of awareness of them. ("I don't recall them getting any awards for environmental protection. They must not have done anything noteworthy.")

When informed of the company's activities, the respondents were surprised at our involvement and wondered why the company did not inform the public. ("If they do all of these things, why aren't people aware?")

When read a list of dozens of environmental regulations that the utilities are required to meet, the focus groups were not impressed, stating that everybody has to meet regulations. They asked what the company was doing beyond the regulations. One respondent said that the key thing was for utilities to take responsibility for being part of the problem. Others indicated that regardless of what the utility was doing there was still room for improvement and that utilities should take a leadership role in dealing with environmental issues. ("WPS should be the good guy. They should look at the environmental impact of what they do, not just because the Department of Natural Resources says so.") They worried about what kind of world they were leaving to their children. ("I have

three kids at home and they'll have to live here a lot longer than I do.")

We next probed the *conservation* issue. WPS has strongly promoted energy conservation for years, so it was quite surprising to find these customers indicate they hadn't heard much from the company on conservation. In fact, they felt that Public Service had put energy conservation on the back burner. They wondered what happened to the energy crunch and felt WPS had stopped encouraging people to conserve because the company was not making enough money. ("I remember when they said they didn't want the Christmas lights on and then they raised the rates." "I remember when they had the big kick to save energy. Years later they turned around and said they were not making enough money because everyone was saving.")

Several respondents felt that the utility had to prove that it was really concerned about educating the public about energy conservation. ("Make projections on the bill showing savings. Encourage people to save....") They said companies as well as citizens had to show true "global concern" so that children would have a place to grow up. ("Get involved with heavy duty industry to get them to conserve. You can conserve all you want at home, but what difference will it make?") Others felt the utility was not holding up its end of the bargain by showing how it is conserving itself, by encouraging the development of higher efficiency appliances or by searching for alternative energy sources. ("The reason people put in efficient appliances is because WPS pushes it. You can't blame them for that. But they don't push alternative sources of energy like solar because they won't make any money from it.")

The highest awareness of our energy conservation programs was among those respondents who had

The media seldom feature the many actions that utilities routinely take to protect the environment. To help get the "good news" out, WPS holds regular tours that highlight equipment like this fish protection net at a coal-fired plant.

Wisconsin Public Service

had an energy audit done in their homes. As a whole, the people who had energy audits felt much better about the utility's conservation efforts.

We next looked at *community involvement.* Overall, community involvement, especially by individual utility employees, was perceived very positively by the respondents. ("I work for [a social] planning agency and people from WPS are on almost every single committee we have.") However, they had little awareness about Wisconsin Public Service's community programs. When they knew about the programs, they gave the utility a high rating.

Still, the respondents did not want the utility to spread itself too thin. They felt that the utility should stick to its main goal of providing a safe, efficient, and environmentally sound source of energy at a reasonable price and that its community projects should be energy related. ("Get rid of the 'Say no to Drugs' program. I would rather have her [my daughter] come home and say turn the lights off because we may run out of power.") At the same time, when WPS uses its equipment to assist in building playgrounds, putting in ball park lights, or helping with similar community projects, these activities were viewed very positively. In fact, one person indicated that his attitude about the local nuclear power plant was positively changed by our community involvement.

Wisconsin Public Service

Recognizing that people mistrust the unfamiliar, WPS uses tours at the Kewaunee Plant to put customers in touch with nuclear power technology and, most importantly, the people who operate it.

Overall, the focus groups verified our earlier research. That is, if a utility wishes to increase its already high level of customer satisfaction, it needs to develop strong leadership in the environment, conservation, and the community.

Still, a mystery remained, for WPS had done much over the last several years to do just that, and, by and large, our leadership position had been well publicized. Why weren't these younger customers aware of our environmental, conservation, and community programs?

"Who Do You Trust?"

The answer became clear when we began to probe the issue of hon-

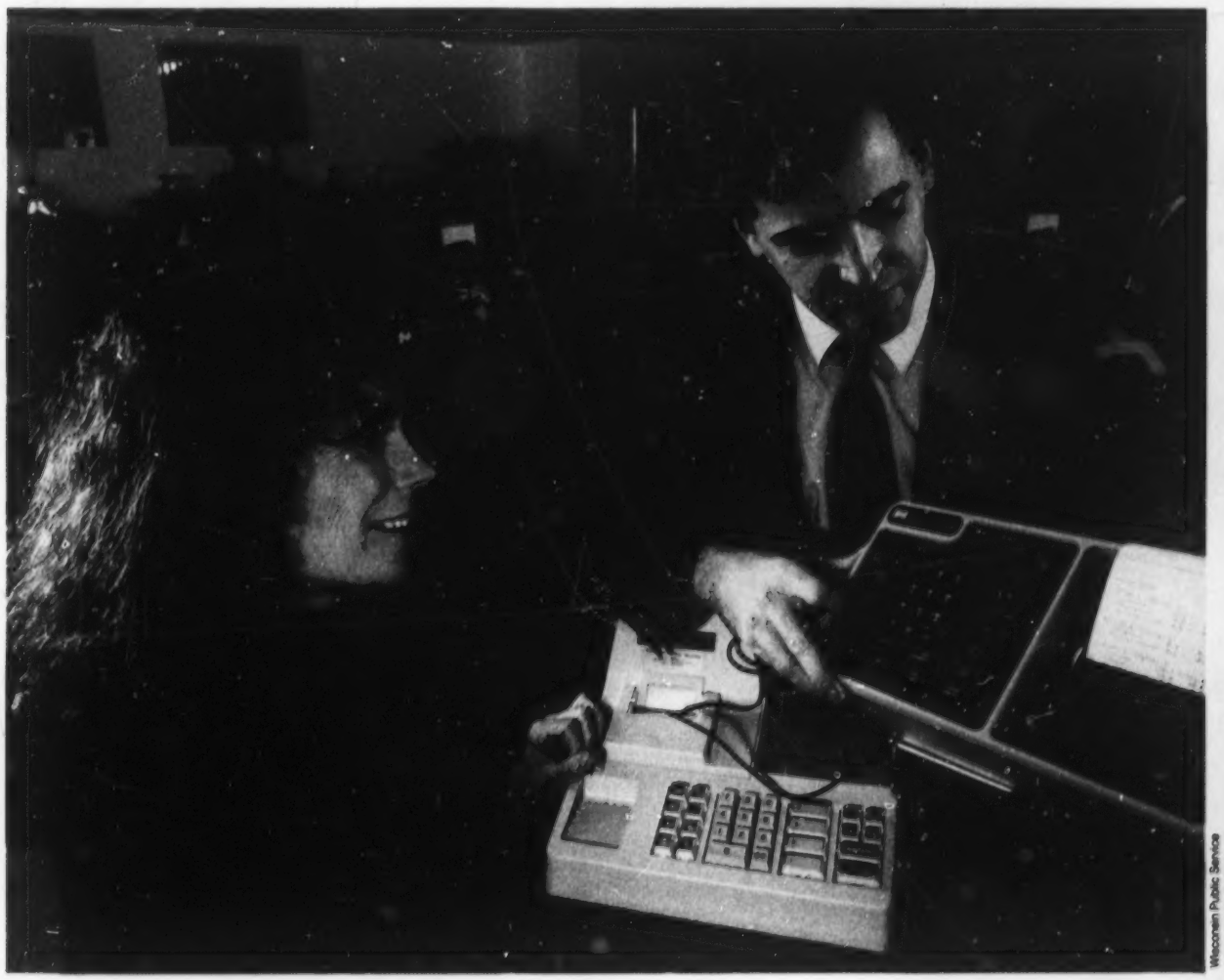
esty. As the focus groups discussed this issue, it became evident that this younger age group tended to view not just utilities but all corporations as less than honest, even though they tended to trust individual employees. ("My experience with the individual has been warm. It you rephrase it to just the corporate entity, it's a different situation." "The big corporate guys just want their money." "They are a monopoly, the only game in town. How honest do they have to be?")

We believe those comments are key to why some people don't remember a utility's message. Because they don't believe the utility is honest, they don't trust what we say about our environmental, conservation, or community activities. So, they tend to dismiss or ignore these messages. Consequently, they don't see any commitment by the utility in these areas. The problem is analogous to being stuck in a "loop" in a computer program.

There is an exception to this phenomenon, however. Those customers who had had direct personal experiences with the utility were much more positive in their comments. If they had visited our hydroelectric recreational lands, they felt more positive about the company. If they had had an energy audit, they felt more positive about the company. If they had worked with company volunteers, they felt more positive about the company.

This finding supports other research that suggests whenever a utility program touches or involves cus-

An electrical engineer stationed in each WPS geographic division personally educates customers about power quality issues and helps them solve problems they experience with electronic equipment.



Wisconsin Public Service

tomers in some highly interactive way, they feel more positive about the company than they did before. It is evident from our focus groups as well as from other surveys, including EEI's market segmentation research, that with this higher involvement, customers develop more faith that their utility cares about them and their concerns. In short, personal interaction between the customer and the company, what can be referred to as "high touch" communication, fosters trust.

In the early days of the utility business, most customer-company communication was "high touch." That was because utilities did not operate very "efficiently" back then. Instead of computerized billings, the meter man met with the housewife and sometimes she paid the bill on the spot as he totaled the bill for her. Many utilities had offices in every small community. Some sold appliances.

For the most part those days are gone. As utilities have become more "efficient," they have moved out of the smaller communities to consolidate and centralize their service centers. Many have dropped appliance sales, and almost all rely on computerized billings. Utilities have gone from "high touch" to "low touch," and the price they have paid is the loss of personal contact with their customers.

Thus, the moral of this mystery, at least for Wisconsin Public Service, is clear. Strengthening our leadership position regarding the environment, conservation, and community affairs is essential to gaining the trust of our customers, but it alone is not enough. No matter how conscientious we are about protecting the environment, no matter how progressive we are about conserving energy, and no matter how earnest we are about fulfilling the responsibilities of our corporate citizenship, some customers, especially our younger customers, must witness those characteristics with their own eyes before they will attribute them to us. To gain their trust and support, WPS must go "back to the future" and concentrate on "high touch" programs like environmental tours and home energy audits that demonstrate our leadership in a manner credible to customers predisposed to distrust us.

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FINANCIAL REVIEW

FORECASTED CONSTRUCTION EXPENDITURES—1990-92

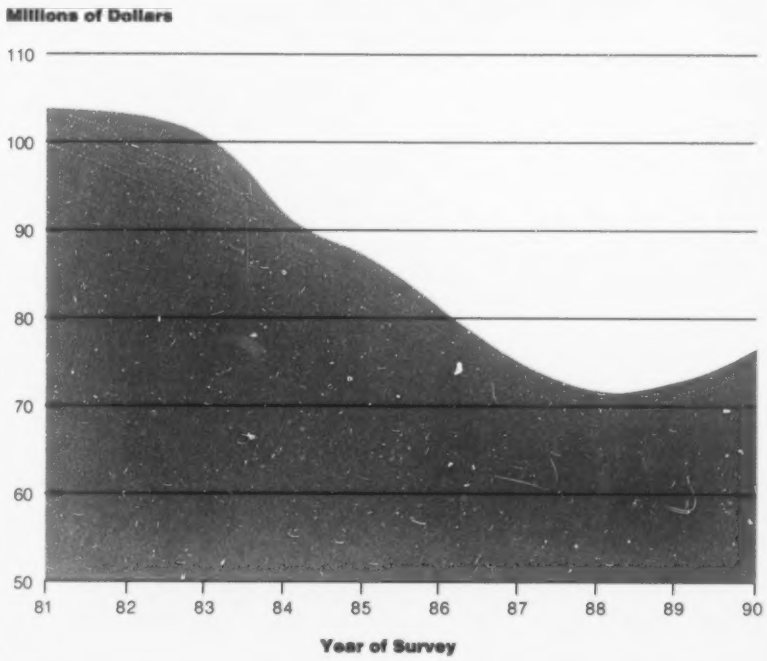
Total electric utility plant construction expenditures for investor-owned electric companies are projected to total $75.4 billion over the three-year period 1990-92 according to Edison Electric Institute's 1990 Construction Survey. The survey results suggest the end of one recent trend in construction spending and the strengthening of another.

As shown in Figure 1, forecasted electric plant construction expenditures steadily declined over much of the 1980s. The 1989 and 1990 survey results, however, suggest that that trend may be coming to an end.

The 1980s also saw spending on Transmission and Distribution facilities claim a growing share of utilities' projected construction budgets, and that trend continues to be apparent in the latest survey. In fact, T&D expenditures over 1990-92 are expected to account for over half of total electric utility plant construction spending, while generating plant will account for only 35 percent. (As recently as 1985 generating plant represented 64 percent of total construction spending.)

Table 1 presents the results of the 1990 survey. One hundred and nineteen investor-owned electric utilities, representing 98.5 percent of the industry's assets, were surveyed. On average, the companies applied a 4.9 percent annual rate of escalation.

Figure 1
Projected Three-Year Electric Plant Construction Expenditures (Total For Current and Following Two Years)



Nuclear Plant

The survey indicates that nuclear construction expenditures will continue to decline through 1992. The expenditures forecasted are related primarily to the completion of one plant that remains under construction and the retro-fitting of existing plants to meet regulatory requirements.

During 1989, two nuclear units went into commercial operation in the United States, bringing the number of electric utility reactors in operation to 109. One of the three units expected to go into commercial operation sometime this year already has and the other two have received full power operating licenses.

Coal Plant

Coal generation construction expenditures are projected to increase gradually through 1991 and then decline slightly in 1992. Although coal expenditures look to be flat over the entire three-year period, pending clean air legislation has the potential to change that significantly because coal plant expenditures include spending related to the repowering of existing plants and environmental controls. Those companies that indicated that a significant

Table 1
Estimated Electric Plant Construction Expenditures
(Millions of Dollars)

		Forecast			
	1989p	1990	1991	1992	1990-92 Total
Electric Generating Plant					
Nuclear	4,292	3,033	2,559	2,149	7,740
Coal	3,428	3,618	3,722	3,185	10,526
All Other	1,720	2,384	2,750	3,130	8,264
Total Electric Generating Plant	9,440	9,035	9,031	8,464	26,530
Transmission & Distribution Facilities					
Transmission Facilities	2,560	2,645	3,101	3,377	9,123
Distribution Facilities	8,661	9,475	9,649	9,653	28,778
Total T&D Facilities	11,221	12,120	12,750	13,030	37,900
General and Miscellaneous Plant	1,637	2,031	1,909	1,790	5,731
Nuclear Fuel	1,521	1,710	1,741	1,794	5,244
Total Electric Utility Plant	23,819	24,897	25,431	25,078	75,406
AFUDC in Total	2,326	1,423	1,083	968	3,474

p=preliminary estimate
Note: Expenditures by combination companies for gas and other non-electric utility plant are not included.

portion of their anticipated construction expenditures would be related to coal estimate that about 25 to 35 percent of that spending would be for environmental controls.

During 1989, investor-owned electric utilities put three new coal units into service with a combined capacity of 2,815 megawatts. Over the 1990-92 forecast period, the North American Electric Reliability Council projects that a total of five investor-owned units will go into service with a combined capacity of 3,462 megawatts.

Other Generating Plant
Expenditures in 1989 for other electric generating plant were $1.7 billion, a 113 percent increase over the $778 million recorded in 1988. Part of the increase is due to a change in the methodology of the construction survey involving the reclassification of expenditures related to lignite from "Coal" to "Other." However, the increase also reflects the fact that most companies that are planning to build new units over the next few years are concentrating on units that require less capital investment and shorter lead times than do traditional nuclear and/or coal-fired baseload units.

These "other" units are typically combustion turbines, in either conventional or combined cycle configurations. They also include fluidized bed units, hydro facilitiess, repowering and reactivation projects, etc. The primary fuels used in the fossil-fired units in the "other" category are natural gas, coal gas, and lignite.

Transmission and Distribution
T&D expenditures in 1989 increased for the thirteenth year in a row and exceeded generating plant expenditures for the first time since 1969. Survey data indicate that the growth trend in T&D expenditures will continue through 1992, with such expenditures accounting for more than half of all the construction spending forecasted over the three-year period.

AFUDC
Expenditures related to the allowance for funds used during construction are projected to continue declining sharply over the forecast period, dropping from $2.3 billion in 1989 to $968 million in 1992. The decline is consistent with the general decline in expenditures related to the construction of baseload plants.

Contributed by Edison Electric Institute's Finance & Accounting Department.

STATISTICAL REVIEW

ELECTRIC UTILITIES REMAIN THE NATION'S MOST CAPITAL-INTENSIVE INDUSTRY

The investor-owned electric utility industry continues to be the most capital-intensive industry in our economy. In 1988, investor-owned electric utilities on average had to invest $3.15 of capital in order to earn $1.00 of annual revenue, making the industry approximately 1.7 times more capital intensive than mining, the next most capital intensive industry, and over 3 times more capital intensive than the average for all forms of manufacturing. (See Table 1.) It takes more than three years for the investor-owned electric utility industry's revenues from operations to equal its investment in fixed assets. (See Table 2.) In most manufacturing industries, revenues equal investment in less than one year.

The electric utility industry's need for greater capital investment is even more striking when contrasted against the retail trade industry, which requires an investment of only $0.53 to earn $1.00 of annual revenue and about six months for its revenues to equal its assets.

In real terms, the ratio of capital investment required per dollar of annual revenue has taken a slight upward trend over the 1980s after declining from about 4.0 in the early 1970s to a low of 2.78 in 1981. The earlier decline in the ratio was probably related in part to the increase in fuel prices

Table 1
Capital Assets Required per dollar of revenue for major industries

Industry	Assets per Dollar of Revenue/1988
Investor-Owned Electric Utilities [1]	$3.15
Mining [2]	1.90
Communications [3]	1.06
Railroads [4]	1.66
Investor-Owned Gas Utilities & Pipeline Industry [5]	1.39
Manufacturing	
NonDurable Manufacturing Industries	
Food & Kindred Products	$0.67
Textile Mill Products	0.66
Paper & Allied Products	0.84
Printing & Publishing	0.85
Chemicals & Allied Products	1.02
Industrial Chemicals & Synthetics	1.02
Drugs	1.16
Petroleum & Coal Products	1.29
Rubber & Misc. Plastic Products	0.66
Other Nondurable Mfg. Industries	0.51
Average of NonDurable Manufacturing	0.88
Durable Manufacturing Industries	
Stone, Clay, & Glass Products	0.93
Primary Metal Industries	0.78
Fabricated Metal Products	0.68
Machinery, Except Electrical	0.97
Electrical & Electronic Equipment	0.85
Transportation Equipment	0.83
Instruments & Related Products	1.12
Other Durable Manufacturing Products	0.59
Average of Durable Manufacturing Industries	0.84
All Manufacturing	0.86
Retail Trade [2]	0.53
Wholesale Trade [2]	0.37

Note: Averages may reflect independent rounding.

[1] Net Total electric utility assets, average year-end 1987 and year-end 1988, and electric department operating revenues, 1988. *Statistical Yearbook 1988*, Edison Electric Institute, pp. 84-85.

[2] Average Quarterly assets and total annual sales, 1988. *Quarterly Financial Report of Manufacturing, Mining, and Trade Corporations*, U.S. Bureau of the Census 1989, first quarter.

[3] Assets, average year-end 1987 and year-end 1988, and operating revenues, 1988. Moody's Public Utility Manual 1989, vol. 1, p. 2403.

[4] Net investment in plant and equipment, average year-end 1987 and year-end 1988, and operating revenues, 1988. Yearbook of Railroad Facts, Association of American Railroads, p. 1, L1 & p. 25, L111 & L112.

[5] Assets, average year-end 1987 and year-end 1988, and operating revenues, 1988. *Gas Facts*, American Gas Association 1989, p. 144 & p. 153.

associated with the first oil embargo. Changes in the cost of fuel are generally recovered through a fuel adjustment clause, which means that rising fuel prices are reflected relatively quickly in increased revenues. The net effect, therefore, is a reduction in the asset turnover ratio. A second rapid rise in fuel costs from 1979 to 1981 corresponds to another reduction in the asset turnover ratio, while a reduction in fuel cost beginning in 1984 corresponds to an increase in the ratio.

Now that fuel prices and elctricity rates have stabilized, however, the industry's investment in plant is once again dominating the ratio, which has been creeping upward since 1981, a reflection of the construction cycle which peaked in 1984.

Contributed by Edison Electric Institute's Finance and Accounting Department.

Table 2
Required Time For Revenues to Equal Assets

Industry	Years(s)	Months(s)
Investor-Owned	3	2
Mining	1	11
Railroads	1	8
Communications–AT&T	1	1
Drugs	1	2
Petroleum and Coal Products	1	4
Nondurable Manufacturing Industries	0	11
All Manufacturing Industries	0	10
Durable Manufacturing Industries	0	10
Investor-Owned Gas Utilities and Pipeline Industries	1	5
All Retail Trade	0	6
All Wholesale Trade	0	4

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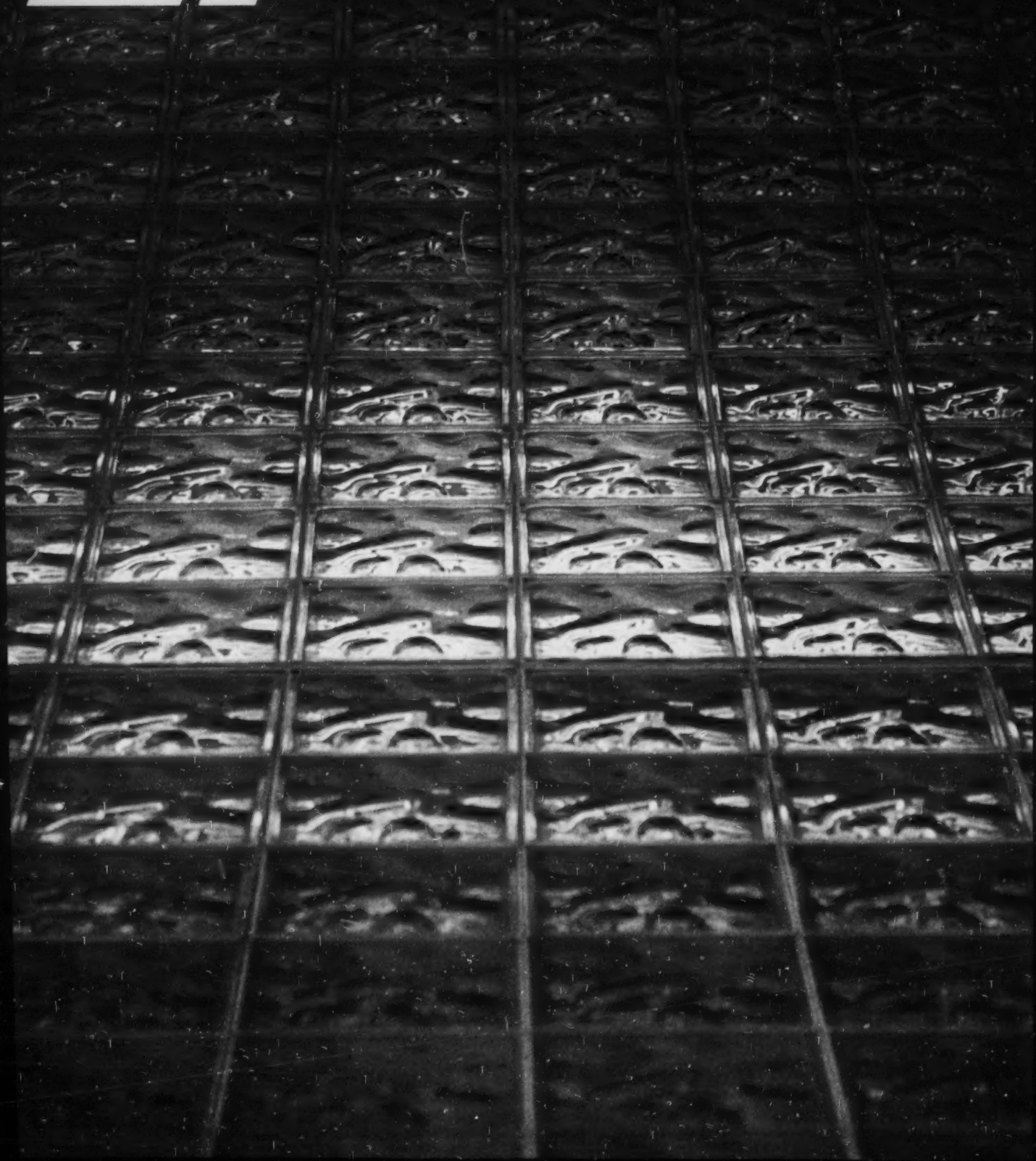

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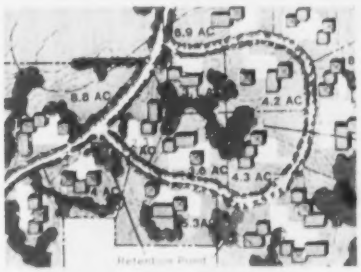

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FINANCIAL REVIEW

FIRST QUARTER EARNINGS PER SHARE DOWN SLIGHTLY

Despite a 3.0 percent increase in electric operating revenues, investor-owned electric utility earnings per share decreased 3.5 percent in the first quarter of 1990 compared to the first quarter of 1989, dropping from $0.57 to $0.55. Higher operating and maintenance costs, reduced allowances for funds used during construction, and a decline in phase-in plan accruals reported during the quarter were primarily responsible for the decline, although lackluster electricty sales also contributed.

Somewhat offsetting the impact of these factors, write-offs for the quarter fell compared to the previous year's first quarter. After-tax write-offs reduced "other income" by $205 million during first quarter 1990, compared to $520 million in first quarter 1989.

Earnings per share (EPS), before extraordinary items, for the twelve months ending March 31, 1990, increased 1.0 percent over the twelve months ending March 31, 1989. The increase in annual EPS was accompanied by a 4.1 percent increase in electric operating income.

Income Statement

Total electric operating revenues increased 3.0 percent from $33.3 billion in the first quarter of 1989 to $34.3 billion in the first quarter of 1990. Total electric operating expenses increased over the corresponding quarter by 3.9 percent, from $26.4 billion to $27.5 billion. The net result of the increases was a decrease in electric operating income of 0.5 percent.

"Other operation and maintenance" expenses, a major component of electric operating expenses, increased by $985 million for the quarter, an 8.6 percent jump over first quarter 1989. The O&M increase was primarily the result of costs, including replacernent power costs, incurred by two companies that had nuclear plants out of service for refueling and preventive maintenance. The large increase in O&M expenses was a major factor behind the increase in the industry's operating ratio, which grew from 79.4 percent for the first quarter of 1989 to 80.1 percent for the first quarter of 1990.

Investment tax credits increased by a net $55 million in the first quarter of 1990 compared to the first quarter of 1989. The increase was caused by several companies using ITC carry forwards.

Due largely to the quarter's relatively mild weather and the resulting drop in natural gas use, "other utility operating income" decreased 8.9 percent for first quarter 1990 compared to first quarter 1989.

Allowance for funds used during construction (AFUDC) decreased by only 7.3 percent from $592 million in the first quarter of 1989 to $549 million in the first quarter of 1990. AFUDC declined at a lower than usual rate because one company, due to a regulatory decision, resumed booking AFUDC during the fourth quarter of 1989 and continues to do so. This company's AFUDC constitutes 36 percent of the first quarter 1990 amount of total AFUDC.

The ratio of AFUDC as a percentage of net income available for common decreased from 19.4 percent in first quarter 1989 to 16.1 percent in first quarter 1990. Total phase-in accruals also decreased on a quarter-to-quarter basis, from $498 million to $395 million, a decline of 20.7 percent.

Other income and deductions increased from $30 million in the first quarter of 1989 to $194 million in the first quarter of 1990, an increase of 555.1 percent. The increase was the result of the lower amount of writeoffs in the first quarter of 1990. The writeoffs were attributable to regulatory disallowances incurred by two companies.

The pre-tax interest coverage ratio without AFUDC increased 1.3 percent from 2.28 times for the twelve months ending March 31, 1989, to 2.41 times for the twelve months ending March 31, 1990. The ratio increased, despite a 3.0 percent increase in net interest charges excluding AFUDC, because of the decrease in writeoffs for the year ending March 31,1990, compared to the previous year.

The return on average common equity (ROE) before extraordinary items was 10.0 percent for the twelve months ending March 31, 1990, up from 9.7 percent.

Table 1
Investor-Owned Electric Utility Industry Statement of Income
(Millions of Dollars)

	Three Months Ending March 31,			Twelve Months Ending March 31,		
	1990	1989r	% Change[3]	1990	1989r	% Change[3]
Total Electric Operating Revenue[1]	$34,287	$33,286	3.0	$141,694	$136,063	4.1
Electric Operating Expenses						
Fuel	$ 7,683	$ 7,770	(1.1)	$ 32,200	$ 31,504	2.2
Other Operation & Maintenance	11,298	10,403	8.6	45,748	43,541	5.1
Depreciation & Amortization	3,813	3,714	2.6	15,194	14,357	5.8
Costs Deferred Under Rate Phase-In Plans	(183)	(211)	(13.5)	(652)	(928)	(29.7)
Taxes Other Than Income Taxes	2,862	2,713	5.5	10,989	10,614	3.5
Income Taxes: Federal & Other	1,519	1,427	6.5	7,107	6,402	11.0
Deferred Income Taxes	457	651	(29.9)	1,951	2,302	(15.2)
Investment Tax Credits, Net	29	(26)	N.M.	(196)	(296)	(33.7)
Total Electric Operating Expenses	$27,477	$26,441	3.9	$112,341	$107,495	4.5
Electric Operating Income	$6,810	$6,845	(0.5)	$29,354	$28,568	2.8
Other Utility Operating Income	644	707	(8.9)	1,146	1,265	(9.4)
Total Utility Operating Income	$7,454	$7,552	(1.3)	$30,499	$29,833	2.2
Other Income & Deductions, Net	194	30	555.1	(575)	(1,220)	(52.9)
Phase-in Deferrals	212	287	(25.9)	913	1,024	(10.8)
Allowance for Other Funds Used During Construction	286	289	(1.0)	1,160	1,405	(17.4)
Total Income Before Interest Charges	$8,147	$8,157	(0.1)	$31,998	$31,042	3.1
Interest Charges						
Interest on Long-Term Debt	$3,777	$3,730	1.3	$15,230	$14,845	2.6
Other Interest Expenses & Charges	319	318	0.2	1,257	1,156	8.8
Allowance for Borrowed Funds Used During Construction	(263)	(303)	(13.2)	(1,152)	(1,342)	(14.2)
Net Interest Expenses & Charges	$3,833	$3,745	2.4	$15,335	$14,659	4.6
Net Income Before Extraordinary Items	$4,314	$4,413	(2.2)	$16,663	$16,383	1.7
Extraordinary Items	0	9	(100.0)	(110)	(77)	43.8
Cumulative Effect of a Change in Accounting Principle	15	(19)	N.M.	(125)	(20)	541.3
Net Income	$4,329	$4,403	(1.7)	$16,427	$16,287	0.9
Preferred Dividends Declared	510	532	(4.2)	2,083	2,150	(3.1)
Net Income Available for Common	$3,819	$3,871	(1.3)	$14,344	$14,137	1.5
Common Dividends Declared	3,128	3,097	1.0	12,842	12,669	1.4
Additions to Retained Earnings	$691	$774	(10.6)	$1,502	$1,468	2.3
Average Shares Outstanding (Millions)	6,922	6,834	1.3	6,905	6,802	1.5
Earnings Per Share Before Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.55	$0.57	(3.5)	$2.11	$2.09	1.0
Earnings Per Share After Extraordinary Items and the Cumulative Effect of a Change in Accounting Principle[2]	$0.55	$0.57	(3.5)	$2.08	$2.08	0.0
Common Dividends Per Share[2]	$0.45	$0.45	0.0	$1.86	$1.86	0.0

Source: EEI Survey Data and Standard & Poors Compustat II Database Service.

[1] Revenues are adjusted for intra-industry electricity sales for resale.
[2] Based on average shares outstanding as reported to EEI by survey respondents and adjusted for stock splits.
[3] Percent changes may reflect independent roundings.
r—Revised to reflect company restatements.
N.M.—Not meaningful.

Table 2
Investor-Owned Electric Utility Industry Balance Sheet
(Millions of Dollars)

Assets	March 31, 1990	March 31, 1989r	% Change[2]
Utility Plant[1]			
Utility Plant (Including Nuclear Fuel)	$489,557	$461,029	6.2
Less Accumulated Depreciation	146,456	132,836	10.3
Total	$343,101	$328,193	4.5
Construction Work in Progress	34,745	40,830	(14.9)
Net Utility Plant	$377,846	$369,023	2.4
Investments	26,877	21,609	24.4
Current Assets	43,770	39,794	10.0
Deferred Debits	34,046	32,371	5.2
Total Assets	$482,539	$462,797	4.3
Capitalization & Liabilities			
Capitalization			
Common Stock	$ 94,822	$ 93,176	1.8
Retained Earnings	52,887	51,981	1.7
Preferred Stock	25,761	26,597	(3.1)
Long-Term Debt	172,043	164,399	4.6
Total Capitalization	$345,513	$336,153	2.8
Current Liabilities			
Short-Term Debt	$ 8,810	$ 7,031	25.3
Long-Term Debt Due Currently	5,701	5,542	2.9
Other Current Liabilities	32,924	31,162	5.7
Total Current Liabilities	$ 47,436	$ 43,735	8.5
Deferred Credits			
Capital Lease Obligations, Non-Current Portion	$ 4,761	$ 4,958	(4.0)
Accumulated Deferred Income Taxes	50,839	46,955	8.3
Accumulated Deferred Investment Tax Credits	15,988	16,438	(2.7)
Other Deferred Credits	18,001	14,558	23.7
Total Deferred Credits	$ 89,589	$ 82,909	8.1
Total Capitalization & Liabilities	$482,539	$462,797	4.3

Source: EEI Survey Data and Standard & Poor's Compustat Database Service

[1] Includes non-electric utility plant.
[2] Percent changes may reflect independent roundings.
r—Revised to reflect company restatements.

Balance Sheet

Construction work in progress (CWIP) decreased from $40.8 billion as of March 31, 1989, to $34.7 billion as of March 31, 1990. CWIP as a percentage of net plant in service dropped from 12.4 percent to 10.1 percent during the same period. Associated with the decrease were increases in total utility plant of 6.2 percent and accumulated depreciation and amortization of 10.3 percent.

Investments for the industry as of March 31, 1990, showed an increase of 24.4 percent to $26.9 billion, up from the $21.6 billion recorded March 31, 1989. The increase in investments was due to several companies' growing investment in non-utility generating subsidiaries.

Total capitalization at March 31, 1990, rose 2.8 percent, an increase of $9.3 billion over the March 31, 1989, amount. The increase was primarily the result of a 4.6 percent increase in long-term debt from $164.4 billion to $172.0 billion. Long-term debt rose from 48.9 to 49.8 percent of capitalization.

The common equity ratio decreased from 43.2 percent to 42.7 percent. Total common equity grew slightly from $145.2 billion at March 31, 1989, to $147.7 billion at March 31, 1990, a 1.8 percent increase.

The increase in the industry's total capitalization was offset by the retiring of preferred stock. As a percentage of total capitalization, preferred stock decreased from 7.9 percent recorded March 31, 1989, to 7.5 percent as of March 31, 1990.

Short-term debt increased by 25.3 percent from $7.0 billion at March 31, 1989, to $8.8 billion a year later. The increase is largely the result of companies' need to use short-term debt for financing while waiting for regulatory approval to use long-term debt.

Tables 1 and 2 are based on unaudited reports submitted by a sample of investor-owned electric utilities. The sample represents approximately 98.1 percent of the industry's total assets and 97.2 percent of its total revenues. The sample data are adjusted with the Standard & Poor's Utility Compustat II database to represent the entire industry. The prior year data also are revised to reflect all company restatements.

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Table 3
1989 Investor-Owned Electric Utility Statement of Cash Flows
(Thousands of Dollars)

	Companies with internal cash generation greater than construction expenditures	Companies with internal cash generation less than construction expenditures	1989 Industry Total	1988 Industry Total	Percent Change 88 to 89
Cash Flows from Operating Activities					
Net Income	$6,885,684	$9,840,574	$16,726,258	$14,956,678	11.8
Depreciation and Amortization	9,083,722	9,929,763	19,013,485	17,959,014	5.9
Extraordinary Items, Discontinued Operations, and Cumulative Effects of Changes in Accounting Principles	(39,373)	(17,485)	(56,858)	1,585,110	N.M.
Deferred Income Taxes and Investment Tax Credits—Net	1,267,882	855,444	2,123,326	2,160,589	(2.6)
Equity in Net Loss (Earnings)	(110,293)	1,428	(108,865)	(150,164)	(27.5)
Loss (or Gain) on Sale of Property, Plant, & Equipment and Sale of Investments	348,250	(139,928)	208,322	(47,266)	(540.7)
AFUDC	(563,351)	(1,850,076)	(2,413,427)	(2,841,076)	(15.1)
Other Internal Sources—Net	2,306,995	(1,692,512)	614,483	1,823,776	(66.3)
Net Cash Flow from Operating Activities	$19,179,516	$16,927,208	$36,106,724	$35,466,661	1.8
Cash Flows from Investing Activities					
Plant Additions—Net of AFUDC[1]	($9,271,622)	($15,558,324)	($24,829,946)	($23,095,117)	7.5
Acquisitions	(118,100)	(1,406,494)	(1,524,594)	(489,221)	211.6
Sale of Property, Plant, & Equipment	187,238	2,473,815	2,661,053	410,162	548.8
Investments—Increase	(2,595,597)	(3,952,854)	(6,548,451)	(6,041,165)	8.4
Sale of Investments	1,193,046	2,660,012	3,853,058	3,880,660	(0.7)
Other Investing Activities	(284,336)	(329,505)	(613,841)	(527,741)	16.3
Net Cash Flow from Investing Activities	($10,889,371)	($16,113,350)	($27,002,721)	($25,862,422)	4.4
Cash Flows from Financing Activities					
Sale of Common Stock	$712,977	$1,635,859	$2,348,836	$2,119,037	10.8
Sale of Preferred Stock	53,100	803,024	856,124	906,437	(5.6)
Purchase of Common Stock	(251,607)	(186,536)	(438,143)	(454,140)	(3.5)
Purchase of Preferred Stock	(749,567)	(522,566)	(1,272,133)	(1,675,161)	(24.1)
Cash Dividends on Common Stock	(5,401,811)	(7,585,156)	(12,986,967)	(12,851,839)	1.1
Cash Dividends on Preferred Stock[2]	(489,436)	(876,299)	(1,365,735)	(1,026,174)	33.1
Issuance of Long-Term Debt	6,731,302	13,198,192	19,929,494	17,204,149	15.8
Retirement of Long-Term Debt	(8,390,171)	(9,250,975)	(17,641,146)	(14,547,680)	21.3
Short-Term Debt—Increase (or Decrease)	(506,592)	1,872,286	1,365,694	(220,397)	N.M.
Other Financing Activities	1,714	149,832	151,546	158,858	(4.6)
Net Cash Flow from Financing Activities	($8,290,091)	($762,339)	($9,052,430)	($10,386,910)	(12.8)
Net Increase (or Decrease) in Cash and Cash Equivalents	$54	$51,519	$51,573	($782,671)	N.M.
Net Internal Cash Flows as a Percentage of Cash Construction Expenditures[3]	143.32	54.41	71.4	75.1	
Total Companies Reported	51	62	113	113	

[1] Includes expenditures for nuclear fuel and non-electric utility and unregulated subsidiary construction expenditures.
[2] Excludes subsidiary preferred dividends.
[3] Net internal cash flows as a percentage of cash construction expenditures for the industry was calculated by dividing net cash flows from operating activities less cash dividends by plant additions net of AFUDC. For companies for which net internal cash flows exceeded plant additions, plant additions were subtracted from net cash flows from operating activities (minus cash dividends) to obtain the "excess" internal generation. This excess was deducted from the industry net internal cash flow for the purposes of obtaining the industry internal generation percentage only.
r—Revised.
N.M.—Not meaningful.
Source: Standard & Poor's Compustat Services and companies' annual reports.

1989 NET CASH FLOWS DECLINE

Although investor-owned electric utilities' net cash and cash equivalents increased by more than $800 million in 1989 compared to 1988, the industry's ability to finance construction with internally generated funds actually weakened according to Edison Electric Institute's 1989 Electric Utility Industry Statement of Cash Flows.

Net internal cash flows (after the payment of cash dividends) dropped from 75.1 percent of cash construction expenditures in 1988 to 71.4 percent in 1989. (See Table 3.) Increased construction expenditures by non-electric operations and unregulated subsidiaries combined with an increase in preferred dividends to cause the decline.

EEI's Cash Flows Statement is based on the Financial Accounting Standards Board's Statement No. 95. EEI's Statement provides consolidated cash flows for 113 companies. Data were collected at the "common stock level;" that is, non-electric utility and unregulated operations are reflected in the Statement. Information was obtained from Standard & Poor's Utility Compustat II database and from utility companies' annual reports.

Individual company data were adjusted to exclude the portion of internally generated cash above 100 percent of construction expenditures, thereby eliminating the apparent effect of companies with an "excess" of internal funds "financing" companies with less than 100 percent internal generation. The calculations do not take into account investing activities other than construction expenditures which impact cash flow. Also, with the exception of cash dividend payments, the effects of external financing actions are not considered.

Operating Activities

Net cash flow from operating activities increased 1.8 percent, from $35.5 billion in 1988 to $36.1 billion in 1989. Contributing to the rise was an 11.8 percent increase in net income. The significant increase in income was offset by the non-cash effects of extraordinary items and cumulative changes in accounting principles. The net effect of the two factors was to add cash in 1988 on the Statement.

Depreciation expense, which is added to net income as a cash flow item, increased 5.9 percent. The cash content of earnings was 18.1 percent higher in 1989 due to a lower level of allowance for funds used during construction accrual.

Deferred income taxes and investment tax credits decreased 2.6 percent to $2.1 billion in 1989. The combined tax items had decreased 51.4 percent from 1987 to 1988. What had been a significant contribution to industry cash flow prior to the Tax Reform Act of 1986 has leveled off at a much lower amount. Deferred taxes and investment tax credits, which had represented 13.6 percent of net internal cash flows for 1987, contributed only 5.8 percent for 1989.

The $256 million net increase to 1989 cash over 1988 for the loss on sale of proerty, plant, and equipment was the result of one company's recording a $336 million loss on the transfer of a generating plant asset.

Investing Activities

Cash construction expenditures (plant additions net of AFUDC) increased from $23.1 billion in 1988 to $24.8 billion in1989, a 7.5 percent increase. The primary reason for the rise is the increase in construction expenditures by non-electric and unregulated subsidiaries.

Approximately 21 companies with an estimated $912 million of predominantly non-utility construction are included in the construction amount shown for 1989 in Table 3. The projects included cogeneration and independent power projects of unregulated subsidiaries, mining, and telecommunications.

Investments increased 8.4 percent from $6.0 billion in 1988 to $6.5 billion in 1989. Like the increase in the industry's cash construction number, the inclusion of companies' investments for non-electric and unregulated operations contributed to the totals. These operations included financial services and instruments, wastewater treatment facilities, telecommunications, fuel supply operations, and non-utility power projects. While investments were up in 1989, the sale of investments remained flat at about $3.9 billion.

Acquisitions totaled $1,524.6 million in 1989, a 211.6 percent increase over the $489.2 million recorded in 1988. The bulk of the

difference, $1,340.0 million, is attributable to one company. The large increase in the acquisition category helped suppress growth in the industry's net cash flow.

The sale of property, plant, and equipment increased from $410.2 million in 1988 to $2,661.1 million in 1989. One company's addition of $1,745.0 million through a sale and leaseback transaction for a generating unit was largely responsible for the 549 percent increase in this category.

Financing Activities

External financing in 1989 increased over 1988, returning approximately to the level experienced in1987. Overall, the total of common and preferred stock sales and the issuance of long-term debt increased 14.4 percent.

The issuance of long-term debt increased by 15.4 percent from $17.2 billion in 1988 to $19.9 billion in 1989. While common stock sales increased 10.8 percent to $2.3 billion, preferred stock sales declined by 5.6 percent to $856.1 million. An estimated $1.5 billion of 1989 common stock sales were made through stock purchase plans. The increase in debt issuance served to increase debt as a percentage of total capitalization for the industry by 0.2 percentage points to 49.6 percent, as close as the industry has been to the 50 percent ratio since 1981.

The use of short-term debt dramatically increased during 1989, up almost $1.6 billion net. The increase was due to the decline in short-term interest rates over the last eight months of 1989, which made short-term debt an attractive financing option.

Total capital reductions, excluding short-term debt, reached $19.4 billion during 1989, a 16.0 percent increase over the $16.7 billion in reductions attained in 1988. Long-term debt retirements rose from $14.5 billion in 1988 to $17.6 billion in 1989, a 15.8 percent increase.

Conversely, 1989 retirements for preferred stock and common stock buybacks decreased compared to 1988. Although the decrease in the buyback of common was slight, preferred retirements were significant, increasing by $403 million, or 24.1 percent compared to 1988. In fact, preferred reductions exceeded issuances by $416 million in 1989. For 1989, the industry's capitalization ratios were common stock, 42.8 percent; preferred stock, 7.6 percent; and long-term debt, 49.6 percent. Compared to 1988, common gained 0.1 points, preferred lost 0.3 points, and long-term debt gained 0.2 points.

Dividend payments in 1989 exceeded the previous year's payments by $475 million, a 3.4 percent increase. About $350 million of the difference was attributable to an increase in the payment of preferred dividends; that increase, in turn, was related primarily to one company's payment of almost $400 million of dividends in arrears.

Company Segmentation by Cash Flow Coverage of Construction Expenditures

Columns 1 and 2 of Table 3 break the industry into two groups: 51 companies whose net cash flows from operating activities were greater than or equal to their total cash construction expenditures and 62 companies whose internal sources of funds did not cover total cash construction expenditures.

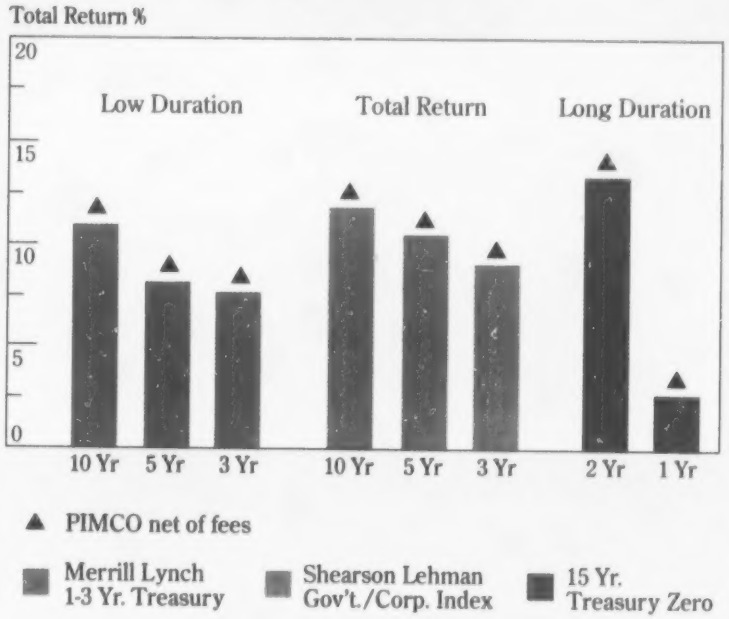
Net internal cash flows for the first group averaged 143.3 percent of cash construction expenditures. For the second group, they averaged only 54.4 percent. For the first group, AFUDC as a percentage of net income averaged only 8.1 percent; for the second group, it averaged 18.8 percent.

The second group of companies incurred significantly larger construction expenditures than the first group. Those 62 companies accounted for 62.7 percent of total plant additions although they represent only 55.7 percent of the industry's total assets. Each of the second group companies averaged $250.9 million in plant additions in 1989. In the first group the average was only $181.8 million.

Contributed by Edison Electric Institute's Finance and Accounting Department.

Nuclear Decommissioning Trust Fund Management

Composite Performance Through 6/30/90



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STATISTICAL REVIEW

FIRST QUARTER SALES UP 1 PERCENT

Electricity sales to ultimate customers by investor-owned electric companies increased during the first quarter of 1990 by 1.0 percent over their first quarter 1989 level, growing from 499.9 to 504.9 million megawatthours.

Slow economic growth combined with mild weather to temper sales. Industrial activity, as measured by the Federal Reserve Board Index of Production, increased only slightly from an average of 107.7 in the first quarter of 1989 to 108.0 in 1990. Real Gross National Product (in constant 1982 dollars) rose by 2.1 percent over the first quarter of 1989.

Heating degree days during first quarter 1990 fell by 14.4 percent compared to first quarter 1989. (A heating degree day measures the extent to which mean outdoor temperature falls below 65 degrees Fahrenheit. One heating degree day is counted for each degree by which a calendar day's average temperature falls below the 65 degree base.)

On a qarterly basis, commercial sales increased by 2.2 percent, the largest increase recorded among the major customer classes. Consistent with industrial production's performance compared to that of Gross National Product, industrial sales grew by only 0.4 percent. Weather-dependent residential sales actually showed a 0.3 percent drop.

On an annual basis, sales increased to 2,023.4 million megawatthours for the twelve months ending March 31, 1990, up 2.3 percent from the 1,978.2 million megawatthours sold during the twelve months ending March 31,

Table 1
First Quarter Customer, Sales, and Revenue Data for Investor-Owned Electric Utilities

	Three Months Ending March 31,			Twelve Months Ending March 31,		
	1990	1989	% Change	1990	1989	% Change
Number of Customers						
Residential	73,343,441	72,167,002	1.6	72,754,298	71,680,394	1.5
Commercial	9,190,936	8,981,849	2.3	9,120,218	8,936,721	2.1
Industrial	372,382	369,403	0.8	378,068	370,617	2.0
Street & Highway	137,222	131,703	4.2	135,023	130,931	3.1
Other Public Authorities	155,760	153,891	1.2	155,246	151,773	2.3
Railroads	22	22	0.0	22	22	0.0
Interdepartmental	471	466	1.1	465	461	0.9
Total Customers	83,200,234	81,804,336	1.7	82,543,340	81,270,919	1.6
Electricity Sales (MWh)						
Residential	172,906,061	173,451,093	(0.3)	656,674,536	648,120,212	1.3
Commercial	143,582,324	140,528,910	2.2	598,821,906	578,530,008	3.5
Industrial	171,513,385	170,758,447	0.4	705,009,700	691,927,962	1.9
Street & Highway	2,728,644	2,718,293	0.4	10,464,319	10,387,936	0.7
Other Public Authorities	12,994,029	11,341,221	14.6	47,960,262	44,825,629	7.0
Railroads	628,798	618,551	1.7	2,480,420	2,413,931	2.8
Interdepartmental	541,375	436,282	24.1	2,009,578	1,962,944	2.4
Total Sales	504,894,616	499,852,797	1.0	2,023,420,721	1,978,168,622	2.3
Revenues ($000)						
Residential	13,329,599	12,881,719	3.5	52,514,869	50,827,585	3.2
Commercial	10,346,489	9,855,072	5.0	43,693,033	41,574,208	5.1
Industrial	8,130,110	7,913,321	2.7	34,236,101	33,148,847	3.3
Street & Highway	308,913	299,609	3.1	1,218,309	1,183,991	2.9
Other Public Authorities	620,981	587,221	5.7	2,484,173	2,363,312	5.1
Railroads	39,343	36,681	7.3	160,260	151,904	5.5
Interdepartmental	26,718	28,647	(6.7)	104,920	118,092	(11.2)
Total Revenues	32,802,153	31,602,270	3.8	134,411,665	129,367,939	3.8

SOURCE: Edison Electric Institute, Statistics Department.

1989. Annual revenues increased by 3.8 percent, while quarterly revenues increased by 3.8 percent.

The total number of ultimate customers increased by 1.6 percent on an annual basis and by 1.7 percent on a quarterly basis. Quarter to quarter, the number of commercial customers grew by 2.3 percent, the number of residential customers grew by 1.6 percent, and the number of industrial customers grew by a slight 0.8 percent. Because customer data are not weighted by class, the much larger residential class dominates the commercial and industrial classes.

The average revenue per kilowatthour sold to all customers rose 2.8 percent from 6.32 cents during the first quarter of 1989 to 6.50 cents during the first quarter of 1990. On an annual basis, the average revenue per kilowatthour sold increased by 1.6 percent.

Contributed by Edison Electric Institute's Finance and Accounting Department.